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ENVIRONMENTAL ASSESSMENT BOARD



ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

VOLUME: 17

DATE: Wednesday, May 22, 1991


BEFORE:

HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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Corrections to Testimony - Volume 16

<u>Page</u>	<u>Line</u>	<u>Correction</u>
2857	8	"programs" should read "stations"
2858	11	"replacement" should read "refurbishment"
2860	1	"hydraulic" should read "fossil"
2860	3	"fossil" should read "hydraulic"

Corrections to Testimony - Volume 17

<u>Page</u>	<u>Line</u>	<u>Correction</u>
2950	2	Replace "add" by "multiply by"
2957	22	after "F&D run" insert "by customer damage cost"
2978	19	"18 months" should read "12 months"
3017	8	Replace "very quickly" by "in about 8 hours"

ENVIRONMENTAL ASSESSMENT BOARD
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act,
R.S.O. 1980, c. 140, as amended, and Regulations
thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro
consisting of a program in respect of activities
associated with meeting future electricity
requirements in Ontario.

Held on the 5th Floor, 2200
Yonge Street, Toronto, Ontario,
on Wednesday, the 22nd day of May,
1991, commencing at 10:00 a.m.

VOLUME 17

B E F O R E :

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1 ---Upon commencing at 10:00 a.m.

2 THE REGISTRAR: Please come to order.

3 The hearing is now in session. Please be seated.

4 ---Off the record.

5 RONALD TABOREK,
6 DAVID BARRIE,
7 JOHN KENNETH SNELSON,
8 JUDITH RYAN; Resumed

8 DR. CONNELL: Mr. Chairman, I would like
9 to just raise one more question, if I might, following
10 on from yesterday's presentation.

11 I don't know if the panel have the
12 transcript. It doesn't particularly matter. I am
13 looking at page 2808, when Mr. Taborek was describing
14 unsupplied system minutes, and I thought I had a good
15 grasp of the concept, but I wasn't sure after I read
16 the transcript, and I thought you might help me by
17 clarifying it.

18 I take it that unsupplied system minutes
19 comes out of a computer program which you described in
20 a perfunctory way. As you say at line 19, "You get out
21 a term for megawatthours for energy, but to scale it to
22 the size of your system, we divide it by the peak load
23 to get system minutes."

24 I take it, conceptually, there is no
25 difference as to whether the entire system was shut

1 down for, let us say, 25 minutes, or different parts of
2 it were shut down, so that the average across the
3 system was 25 minutes at different times?

4 MR. TABOREK: That's correct. The
5 calculation will basically look at occurrences over the
6 full-time period in which energy was not supplied and
7 it will determine it in megawatthours, the measure of
8 energy, and that's energy not supplied.

9 Now, that number by itself, if you were
10 experiencing that on a large system, that would have
11 one effect relative to the system. If you were
12 experiencing that number of megawatthours on a small
13 system, it would be a much bigger affect.

14 So in an attempt to express the
15 unsupplied energy in megawatthours, in a yardstick or a
16 measuring stick that is more related to the system,
17 it's divided by some convenient measure of the system
18 size. And so the peak is chosen and so you get system
19 minutes. And it is just a convenience to scale it to a
20 more meaningful number that you can compare two
21 different-sized systems.

22 DR. CONNELL: Right. Now, I take it we
23 are talking about interruptions here, which are the
24 result of some problem in the bulk system.

25 MR. TABOREK: Generally, there is

1 generically two causes, one that the load may be higher
2 than you think or the generation may be lower than you
3 think or it is an and/or, both happening together.

4 DR. CONNELL: But this does not include
5 problems at the local municipal utility level?

6 MR. TABOREK: No. It's strictly related
7 to generation. There is no transmission whatsoever.

8 DR. CONNELL: And have you ever compared
9 your analysis to actual experience?

10 MR. TABOREK: The way in which we did
11 that was our review of experience that we described to
12 you yesterday, which is not an attempt to apply our
13 analysis directly and relate the model to real life.
14 The reason you don't do that is these events that we
15 are trying to model are very rare. And typically, they
16 happen in the order of, what, once every 10 years? So
17 sorting through, to find these rare and unusual
18 experiences to match your model is a difficult thing to
19 do. That's why we tried this other approach.

20 Now, in the field of reliability theory
21 development, there is a body of work that is attempting
22 to -- in putting more emphasis on attempting to model,
23 to fit model results with actuals, but we have haven't
24 done that in this work.

25 I seem to recall, if you will just excuse

1 me... In the early work that Hydro did in this field,
2 yes, in November 1978, a Mr. North from Hydro wrote up
3 a memo, Frequency and Duration Program, Rough
4 Comparison with Operational Past History. I have not
5 found that and I am not aware, and I haven't pursued it
6 very much because I don't think it gives that much
7 additional information for what we are trying to do.

8 As I say, it's a very difficult thing to
9 try to match the theory with the experiments, or with
10 the actuals.

11 DR. CONNELL: Thank you very much.

12 THE CHAIRMAN: Mr. Watson?

13 MR. WATSON: Thank you, Mr. Chairman.

14 I have with me Mr. Douglas Logan, he is a
15 specialist in reliability analysis, resource planning
16 and avoided cost. As a result you may see him in some
17 later panels.

18 The material that I will be referring to,
19 I believe has been outlined for you, Exhibits 3, 4, 6,
20 21 and 87.

21 In addition, there are some documents
22 which are not exhibits, which I will be referring to
23 and which have been provided to the clerk and will be
24 provided to you as we go through the cross-examination.
25 And finally, there is a document, again, which is

1 provided to the clerk and to the various intervenors.
2 Basically, it is excerpts from the various full
3 documents and it should provide a very simple way for
4 people to to follow through on the cross-examination.

5 Mr. Chairman, I am going to start with
6 reserve margin questions, so I imagine I will be
7 devoting most of these to Mr. Taborek and perhaps Mr.
8 Snelson.

9 If I could start with the 1989
10 performance report, the BES reliability, pages 19 and
11 20, if you could turn that up, please?

12 THE CHAIRMAN: Is this an exhibit number?

13 MR. WATSON: No, it isn't. The clerk has
14 it. If he could provide you, first of all, with the
15 document which has a document precis on the front, and
16 the document which I just referred was the '89
17 performance report, that should be the next item, Mr.
18 Clerk.

19 THE CHAIRMAN: Should this document
20 precis be marked as an exhibit?

21 MR. WATSON: I intend to refer to
22 everything in it. Yes, we can mark it as the next
23 exhibit.

24 THE CHAIRMAN: That will be the next
25 exhibit, then; number?

1 THE REGISTRAR: That will be No. 137, Mr.
2 Chairman.

3 ---EXHIBIT NO. 137: Document precis.

4 MR. WATSON: And the next document is the
5 1989 performance report, the BES reliability.

6 THE CHAIRMAN: And that is not an exhibit
7 prior to this time, I take it, is that right? It's a
8 Hydro document.

9 MR. WATSON: It's a Hydro document. It's
10 a response to interrogatory 2.7.81, partial response to
11 that. I don't believe it's an exhibit already.

12 THE CHAIRMAN: It probably should be
13 marked as an exhibit also. 138.

14 THE REGISTRAR: 138.

15 ---EXHIBIT NO. 138: Hydro 1989 performance report,
16 BES Reliability; response to
Interrogatory 2.7.81.

17 MR. WATSON: Just by way of illustration,
18 Mr. Chairman, I will be giving you a series of
19 documents, such as '89 performance report. They are
20 the complete documents, by and large; however, the
21 document precis that I have given you has excerpts from
22 those various documents and I am hoping that we should
23 be able to just refer to the documents behind the
24 document precis, save for questions that do come up,
25 where the panel requests that we look at the full

1 document. So subject to that, I hope we can proceed
2 along those lines.

3 CROSS-EXAMINATION BY MR. WATSON:

4 Q. So Mr. Taborek, if we could refer to
5 pages 19 and 20, which you will note are pages 1 and 2
6 of what I will call Exhibit No. 137.

7 Mr. Taborek, we see there that total
8 transmission unreliability is equal to transmission
9 facilities' unreliability, plus transmission security
10 unreliability; is that correct?

11 MR. TABOREK: A. Yes. What I would like
12 to do, Mr. Watson, Mr. Barrie will speak to this
13 particular document, so he will take your questions.

14 Q. Certainly.

15 MR. BARRIE: A. This a report put out by
16 Power System Operations division so I would like to try
17 to answer your questions.

18 Q. Okay. Thank you, Mr. Barrie.

19 So that is correct, transmission
20 unreliability is the sum of those two components?

21 A. That is correct, yes.

22 Q. Now, you will notice on pages 19 and
23 20, under both of those headings there are figures for
24 the unreliability for the 1989, 1988 and 1987?

25 A. Yes.

1 Q. I have added those figures and they
2 come to the following numbers, 9.8 system minutes for
3 1989.

4 THE CHAIRMAN: Perhaps you could give us
5 the figures that you have added. Could you do that,
6 please?

...

1 [10:13 a.m.] MR. WATSON: Certainly.

2 The transmission facility unreliability
3 for 1989 is 9.3. That is at the top of page 19, the
4 first line.

5 THE CHAIRMAN: Yes.

6 MR. WATSON: The transmission facilities'
7 unreliability for '88 is 21 system minutes. That's the
8 second paragraph, underneath the transmission
9 facilities' unreliability, the first line of that.

10 And for 1987, the third paragraph, the
11 first line, the unreliability was 9.3 system minutes.
12 You will see in Exhibit 137 that I have actually
13 circled the numbers. That should make it somewhat
14 easier.

15 THE CHAIRMAN: Right.

16 MR. WATSON: Under transmission security,
17 the numbers are, for 1989, 0.54 system minutes; 1988,
18 0.9 system minutes; and 1987, 0.13 system minutes.
19 Again, those numbers are all circled on Exhibit 137.

20 Q. So, Mr. Barrie, by my calculations
21 the totals are 9.8 system minutes for 1989, 21.9 for
22 '88 and 9.4 for '87.

23 MR. BARRIE: A. Yes.

24 Q. Now, Mr. Barrie, I would like you to
25 refer to the transmission product quality performance,

1 the review for 1989.

2 Mr. Clerk, if you could give that to the
3 Board, please?

4 THE CHAIRMAN: This is to be the next
5 exhibit, is it?

6 MR. WATSON: Yes, please.

7 THE REGISTRAR: No. 139, Mr. Chairman.

8 THE CHAIRMAN: Thank you.

9 ---EXHIBIT NO. 139: Transmission Product Quality
10 Performance Review for 1989.

11 MR. BARRIE: Page 3 has the executive
12 summary of that?

13 MR. WATSON: That's correct, Mr. Barrie,
14 page 3 of Exhibit 137 has the executive summary, and
15 that is the only page I will be referring to right now.

16 Q. You will notice figure ES1 refers to
17 customer delivery interruption. Is this another
18 measure of unreliability?

19 MR. BARRIE: A. Yes, it is.

20 Q. I notice the figures for 1989, 1988,
21 and 1987 are substantially higher than the values that
22 were produced by the addition of transmission
23 facilities' unreliability and transmission security
24 unreliability. You will see for '89, the former was
25 9.8 system minutes, and in the executive summary, it's

1 22.7. Could you explain the difference between these
2 two sets of figures, please?

3 A. If could I deal with the system
4 minutes first, the first numbers you quoted, the lower
5 numbers.

6 As Mr. Taborek explained, we measure
7 unsupplied energy by taking the megawatthours
8 interrupted. And we normalize that by dividing by the
9 system peak, so we result in a figure that comes out at
10 system minutes.

11 This measurement here, you will notice on
12 page 3, this is not measuring system minutes, it is
13 measuring what is called "effective minutes." There is
14 a distinction between system minutes and effective
15 minutes.

16 THE CHAIRMAN: Where does it say
17 "effective minutes"?

18 MR. BARRIE: It says it all through the
19 page.

20 THE CHAIRMAN: It says, "customer
21 delivery interruption...."

22 MR. BARRIE: The second line, "Customer
23 delivery interruption improved from 32.2 effective
24 minutes."

25 THE CHAIRMAN: Yes, thank you.

1 MR. WATSON: Q. So could you help us out
2 on what the difference is between system minutes and
3 effective minutes? *we measure of unreliability*

4 MR. BARRIE: A. I will try.

5 When we measure interruptions in system
6 minutes, we take no account of a momentary
7 interruption. So, for example, if a customer is
8 interrupted for less than one minute, we define that as
9 a momentary interruption and it does not contribute
10 anything to system minutes.

11 This will typically happen during a
12 lightning storm, perhaps. A transmission line will be
13 taken out of service; it will very temporarily
14 interrupt supplies, until the automatic reclosure
15 equipment puts the line back on. Typically, the
16 customer might be off for ten, fifteen, seconds,
17 something like that.

18 We do not regard that -- when I say "we,"
19 system minutes measurements does not take account of
20 that kind of interruption.

21 In our analysis, we find that, in fact,
22 that does cause customers some annoyance. That is, in
23 fact, an interruption as far as they are concerned. So
24 effective minutes were developed in an attempt to try
25 and reflect that, in some kind of measurement.

1 Now clearly, there is very little
2 unsupplied energy when you have a momentary
3 interruption such as that. It would be very difficult
4 to measure, in fact, how much there was. So what
5 effective minutes does is it has tried to reflect that
6 annoyance to the customer, by adding in a factor of 6,
7 the number 6. So any momentary interruption is given a
8 value of 6. Any interruption longer than one minute is
9 given 6 plus the number of minutes of interruption. So
10 a ten-minute interruption would be 16 effective
11 minutes. That's one key difference between effective
12 minutes and system minutes.

13 THE CHAIRMAN: When you had the
14 ten-minute interruption, what would be the system
15 minute loss?

16 MR. BARRIE: To calculate that, you would
17 have to take the -- if it was the whole system, it
18 would be ten system minutes. If it was a part of the
19 system, one would have to take account of the size of
20 interruption, but that is true both for effective
21 minutes and for system minutes.

also need
to
calculate
whether
interruption
for whole
system or
part of
the system

22 THE CHAIRMAN: Effective minutes also
23 affect -- it is the whole system? It is based on the
24 whole system?

25 MR. BARRIE: Well, this is based on

1 delivery points, but you can add them all up --

2 THE CHAIRMAN: This being, "This is based
3 on delivery points," what is "this"?

4 MR. BARRIE: Sorry, the effective minutes
5 is based on delivery points. But if it were to happen
6 to all of the delivery points, then you could add them
7 all up and you would get effective minutes for the
8 whole system, which is essentially what this graph
9 shows here. This is attempting to show the system-wide
10 performance, by adding them up for the whole, for every
11 delivery point on the system.

12 There is one other essential difference
13 which makes effective minutes higher than system
14 minutes: the normalization. As I mentioned for system
15 minutes, we normalize to system peak. For effective
16 minutes, we normalize to system average. As Mr.
17 Taborek mentioned yesterday, our load factor is around
18 68 per cent, so typically, it would cause effective
19 minutes to be higher for the same event.

20 I have found the only way to rationalize
21 all this is to take examples. We could try and do one,
22 if you will?

23 MR. WATSON: Q. How long would this
24 take?

25 MR. BARRIE: A. Well, just a few days.

1 (Laughter) No.

2 Q. I don't think we need to get into
3 that, unless the panel would like to.

4 A. Essentially the differences are
5 two-fold that I have mentioned. And one is the
6 momentary interruptions which the system minutes
7 totally ignores. The effective minutes takes that into
8 account and the normalization is by system peak, as
9 distinct from average, both of which tend to drive up
10 the effective minutes, as compared to the system
11 minutes. But they are measuring the same thing,
12 really. They are measuring unreliability.

13 Q. Where did the value of 6 come from?

14 A. It was somewhat of a judgment call to
15 try to -- what it's trying to do is to show that
16 momentary interruptions do annoy the customer, but how
17 much do they compare to prolonged outages?

18 And it's a judgment call. I don't have
19 any analysis for the 6.

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25 ...

1 [10:25 a.m.] Q. Is it fair to say that the system
2 minutes is the most relevant for comparison with
3 generation unreliability?

4 A. Most definitely. Effective minutes
5 should not be used at all if comparing to generation,
6 system minutes.

7 Q. What do you use the effective minutes
8 for?

9 A. Effective minutes are used by our
10 regions' branch, our people who are looking at -- they
11 are the people closest to the customer. So, they will
12 be looking at the performance of delivery points across
13 Ontario. They will be assessing the performance of
14 individual delivery points. And a delivery point that
15 has high effective minutes will be one that has poor
16 performance. And it indicates where maintenance work
17 or refurbishment work should be targeted. So it is
18 more to help guide transmission refurbishment work,
19 rather than a measurement of total system.

20 Q. If I could turn now to interrogatory
21 2.26.5? Mr. Barrie, on page 2 of the interrogatory,
22 the answer is given, and it provides two indices. The
23 first one is "System Average Interruption Duration
24 Index," which I understand we can call SAIDI?

25 A. Right.

1 Q. The second one is "Customer Average
2 Interruption Duration Index," which we can call CAIDI?

3 A. Right.

4 Q. Could you give us a definition of
5 SAIDI, please?

6 A. SAIDI represents the number of hours
7 the average customer is out of power in a year.

8 I should say, first of all, these
9 measures are measures of our distribution electricity
10 system. This is what the customer, the ultimate
11 customer, is experiencing. These should not be
12 confused with the previous numbers we were discussing,
13 which were the numbers experienced at bulk supply
14 points.

15 The distinction between the two is that
16 if the customer supplies are interrupted, whether the
17 problem is with the bulk system or whether it is with
18 the distribution system, it is the same thing to the
19 customer when his lights have gone out.

20 So what we are talking about with SAIDI
21 is distribution, plus transmission, plus generation.
22 And I should say, the vast majority of this number is
23 distribution related.

24 So if you will, SAIDI would be a
25 measure -- if we said that system minutes was a

1 representation, was a measure of how often supplies
2 were interrupted at bulk supply points, SAIDI is a
3 measure of how often they are interrupted at the
4 customer terminals.

5 Q. Mr. Barrie, I understand you to say
6 that most of the unreliability is distribution related?

7 A. Yes.

8 Q. Going through, if you will, the
9 hierarchy, do we have distribution, transmission and
10 then generation?

11 A. Yes.

12 Q. Is that fair to say?

13 A. What is your order there? That is
14 the order.

15 Q. The one that causes the most
16 interruption is distribution, as you indicated?

17 A. Yes.

18 Q. The next is transmission?

19 A. Yes.

20 Q. And the next is generation?

21 A. Yes.

22 Q. I suppose if we look over on page 6
23 of Exhibit 137, where we have figure 2.20...

24 A. Yes.

25 THE CHAIRMAN: Where is 2 -- yes, right,

1 I have it.

2 MR. WATSON: Q. We get a graphic
3 illustration of that, when we see that, save for 1985
4 and 1989, generation reliability is effectively zero?

5 MR. BARRIE: A. Correct.

6 Q. I understand that 1989 was a somewhat
7 singular year, because of the loss of several units at
8 Bruce in July, and also some Lennox Oil inventory
9 problems in December. Is that fair?

10 A. 1989 was, as you have described it, a
11 singular year, yes. We experienced problems both in
12 the summer and in December of '89; a combination of
13 factors, very high demand and problems with our
14 generation facilities, yes.

15 MR. SNELSON: A. Could I comment on the
16 relationship that has been discussed between
17 distribution, transmission and generation?

18 Q. Please, Mr. Snelson.

19 A. Clearly, the relationship has been
20 that most of our unreliability has been due to
21 distribution, a lesser amount to transmission, and an
22 even smaller amount due to generation.

23 The relationship of the generation to the
24 others isn't necessarily always going to be that way in
25 the future. It has been that way in the last ten

1 years, because we went into that period with surplus
2 capacity, as Mr. Taborek described yesterday. So that
3 relationship could change. I'm just cautioning, that
4 relationship could change.

5 MR. TABOREK: A. And to build on Mr.
6 Snelson's caveat, figure 2.5 of the report prepared in
7 August 1981, "Reliability Criterion for Generation
8 Planning," which I think you will be introducing as
9 evidence, as part of the evidence here, so we will get
10 an exhibit number later, I presume?

11 Q. We could introduce it right now, if
12 you'd like to make a point, Mr. Taborek, and then the
13 Board could follow along.

14 THE CHAIRMAN: I think we should have
15 some reference to it.

16 MR. WATSON: Why don't we do that? If
17 that could be the next exhibit, Mr. Clerk?

18 THE REGISTRAR: That will be No. 140.

19 ---EXHIBIT NO. 140: Report entitled "Reliability
20 Criterion for Generation
Planning," of August 1981.

21 MR. TABOREK: Figure 2.5 is towards the
22 end of the report, in with all the figures. There is
23 no page number, just the figure number. Yes.

24 What the figure shows is on the vertical
25 axis, the cost of unreliability; and on the horizontal

1 axis, for different generation reserve margins. And I
2 would mention this calculation was done in 1981, so it
3 is a bit dated, but it quite graphically illustrates
4 the point that is being made here.

5 As Mr. Barrie -- it shows on there, the
6 economic cost of distribution reliability, which is the
7 largest -- excuse me, which is the band at the bottom.

8 It then shows an economic cost of
9 transmission reliability, which is the next band up.
10 And these bands are constant for any amount of
11 generation unreliability.

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25 ...

1 [10:35 a.m.] And then, it shows two shaded areas
2 which, in effect, are direct and indirect costs of
3 generation unreliability.

4 And the point was made by Mr. Barrie that
5 the distribution reliability for high reserve margins,
6 I would add, for generation, is the biggest cost of
7 unreliability, followed by transmission. And in
8 circumstances where the reserve margins are adequate,
9 and were coping, that there is very little, if any,
10 generation unreliability cost.

11 But the situation changes very
12 drastically, when you get into inadequate reserve
13 margins and that the economic cost of inadequate
14 generation builds up very, very sharply. And that is
15 an illustration of the point Mr. Snelson made.

16 In a good year, you would get that, as a
17 matter of fact the system is, in essence, designed to
18 be that way. And what we are striving very hard to do
19 is stay away from this precipitous increase that
20 occurs. And that's the same increase that we were
21 looking at in the curves I was showing yesterday, where
22 customer damage costs for low levels of reliability
23 increase quite sharply.

24 And that's why we said, preferably, we
25 would tend to stay towards the more reliable side of

1 the minimum to avoid being catapulted into that region
2 of very high outages and costs.

3 MR. WATSON: Q. And as you correctly
4 pointed out, Mr. Taborek, the very high regions of that
5 curve on Figure 2.5 occur at very low reserve margins,
6 18 per cent is the far left side of that graph.

7 MR. TABOREK: A. You're quite right, it
8 occurs at lower reserve margins.

9 I would caution, actually, reading these
10 numbers off exactly, since this is a dated calculation,
11 but in principle, you are correct. You shouldn't read
12 the numbers too precisely, though.

13 We are tabling, in effect, in Figure 5.1
14 of our review, which you will be asking us about, this
15 equivalent information updated for the present day.

16 Q. And as you were indicating, when you
17 were referring to yesterday's curve, the cost curve, in
18 effect, has a reasonably flat bottom; does it not?

19 A. Yes. In the total system cost, yes.

20 Q. And in effect, what you are talking
21 about is where you are on that curve?

22 A. Yes.

23 Q. Whether you are on the right side and
24 proceeding toward a higher reserve margin, where the
25 slope is less--

1 A. Yes.

2 Q. --or whether you are on of the left
3 side of that curve, proceeding toward a lower reserve
4 margin, where the slope is higher?

5 A. I think you are correct; yes. I am
6 just not sure of the left/right, but yes, you're right.

7 Q. The left is a lower reserve margin.

8 A. Yes.

9 Q. And that increasing slope is
10 reflected, of course, in the Figure 2.5?

11 A. Yes.

12 Q. It's the same sort of the situation?

13 A. Same phenomenon is causing that,
14 right.

15 Q. So. If, in fact, we are somewhere on
16 the bottom of that curve, but we are not actually going
17 up that slope, then that assists us some way in
18 interpreting Figure 2.5 in today's terms, as opposed to
19 the 1981 terms that this curve is precisely defined in?

20 A. Yes. And bear in mind that these
21 calculations are done in terms of expected values. And
22 you will not, each and every year at every point in
23 time, be on that value -- that you are, really, because
24 of the uncertainties -- that curve represents a
25 weighted summation of all your experience, over a

1 period of time. And so that you can have years when
2 you are on either side and it's not by your choice.

3 So in some of our analyses, we have
4 talked about what happens if you get into a bad year,
5 not your expected year. And the nature of generation
6 reliability is that most of the time, when you have
7 anywhere close to your expected values, or your
8 forecast values, things will be well. It's a few bad
9 years that really give you problems.

10 So the moral there is to stay away from
11 this difficult area. To give yourself -- to stay away
12 from it.

13 I often think of this in terms of walking
14 along the edge of a cliff. You can go right up to the
15 edge and everything is fine, but you mustn't go over,
16 because you are in real trouble. This is a reverse
17 cliff here.

18 Q. Just one more question, with Figure
19 2.5.

20 If we look at where generation
21 unreliability meets transmission unreliability, that
22 occurs around 26 and a half, 27 per cent, something
23 like that, on this curve?

24 A. Based at the time these calculations
25 were done and the assumptions they used, yes.

1 Q. And then, if we go to the right on
2 that curve, the point where generation reliability is
3 equal to the sum of transmission and distribution
4 reliability occurs at around 24 per cent?

5 A. Eyeballing it, yes.

6 Q. Roughly?

7 A. Sure.

8 Q. So that the spread between those is,
9 what? About, roughly, two and a half, 3 per cent,
10 something like that? Those are '81 numbers.

11 A. Yes.

12 Q. Is that fair for today?

13 A. We haven't done this calculation in
14 this manner for today, so I can't answer, but...

15 MR. SNELSON: A. I think we can make a
16 judgment and that is that the absolute values, whether
17 this is 26 to 24, will have changed, because the forced
18 outage rates on the system will have been changed; the
19 total size of the system has changed, and so on. So I
20 believe those, the absolute numbers, will not have
21 significance today.

22 I would expect that the difference
23 between the numbers, between the level at which
24 generation unreliability is very small and the point at
25 which it's equal to the sum of transmission

1 distribution, would be about the same number,
2 percentage points of reserve, and that is just a
3 judgment.

4 Q. We have been describing the relation
5 between distribution, transmission and generation. Is
6 Ontario's experience typical among utilities in North
7 America?

8 MR. TABOREK: A. I can't give you a
9 factual answer. I think from my knowledge of the
10 behaviour of generation and transmission systems -
11 mostly generation, not so much transmission - but this
12 kind of a phenomenon I think must inevitably hold true
13 in most utilities.

14 MR. SNELSON: A. I believe it generally
15 does.

16 Q. And certainly, in the last 10 years,
17 would it be fair to say that the experience of other
18 utilities would be the same as Hydro; that is, that
19 generation unreliability has been almost zero?

20 MR. TABOREK: A. Yes. I think
21 especially since the last 10 years have been a period
22 in which people have been coming out of surpluses and
23 utilizing surpluses, so generation reliability has been
24 relatively good.

25 MR. SNELSON: A. There are a few notable

1 exceptions to that. Florida Light and Power, for
2 instance, has been in capacity shortage, as I
3 understand, and has significant unreliability from
4 generation sources. But there are others, too.

5 Q. Panel, if you would turn to page 6A
6 of Exhibit 137? I guess, Mr. Barrie, this question
7 would be directed to you.

8 We had prepared this table before we had
9 had the benefit of your evidence. Could you comment
10 upon the relative nature of the various factors that
11 are listed here?

12 I understand that what you have said may
13 affect the actual numbers that are here. But could you
14 talk about the relative significance of these?

15 MR. BARRIE: A. As I understand your
16 diagram, you took SAIDI, and you took generation and
17 transmission, subtracted it from SAIDI and got
18 distribution?

19 Q. That's correct.

20 A. Right. You can't do that.

21 Q. That's why I prefaced the question
22 the way I did. (Laughter)

23 A. Specifically, the generation, the
24 generation is a problem.

25 Generation unreliability, all of our

1 unreliability measures here, take unsupplied energy.
2 Any form of unsupplied energy will appear as system
3 minutes here. And, of course, the big impact is in
4 1989.

5 When I say you can't do it, it is just
6 1989, really, is the big place that it would be
7 incorrect. In 1989, we had a significant amount of
8 generation unreliability.

9 Q. Sorry, could I just stop you there.
10 Does that mean it is correct for '84 through '88?

11 A. Well, '85 is slightly wrong, as well.
12 Anywhere you have got generation unreliability would
13 make it incorrect.

14 Q. Okay.

15 A. However, it's negligible, except for
16 1989.

17 In 1989, we had a significant amount of
18 generation unreliability. The events that caused that,
19 the unsupplied energy was of the form of voltage
20 reductions and public appeals.

21 Voltage reductions and public appeals
22 would not appear in SAIDI. So if you were to strike
23 out the 109.5, your distribution unreliability in 1989
24 would be of the order of 210, of that order. That's
25 where the calculation is incorrect.

1 Q. If, in fact, the generation
2 unreliability had been due to other factors rather than
3 voltage regulation and appeals, and there had been a
4 figure in there, would the calculation then have been
5 correct?

6 A. If we have interrupted load, if we
7 have actually opened the circuit breakers and cut load
8 in that fashion, yes. But when we save energy by other
9 means, without actually interrupting load, that's where
10 the difference is.

11 Q. And that's not captured with SAIDI?

12 A. Right, right.

13 Q. Is there an index that does capture
14 that? A SAIDI-plus index, if you will?

15 A. Not to my knowledge.

16 Q. How would you calculate that, you
17 would take SAIDI and just add something to it?

18 A. I suppose so, yes.

19 Q. Does Hydro do that?

20 A. No. Well, not to my knowledge.

21 In fact, you would be adding sort of
22 apples and oranges, to some extent. They would both be
23 measures of customer's experience on some loss of
24 energy, but you would be now adding interruptions onto
25 public appeals and voltage reductions. We do that on

1 [11:47 a.m.] THE CHAIRMAN: Now, what was the
2 reference to 1 --

3 MR. WATSON: The reference is the 1989
4 performance report, page 17, which is page No. 7 of
5 Exhibit 137.

6 THE CHAIRMAN: Thank you.

7 MR. WATSON: Q. If you would look at
8 page 17, you will see it is entitled "Total BES
9 Unreliability," and as you go down, there is a heading
10 "Performance Standard." That's broken into two parts:
11 generation unreliability and transmission
12 unreliability. It appears as though the generation
13 unreliability totals 78 system minutes. Is that
14 correct, Mr. Barrie?

15 MR. BARRIE: A. Yes, it is.

16 Q. Now, could you help me with the
17 difference between this standard of 78 system minutes
18 and the new criterion that was referred to yesterday of
19 10 system minutes? Or for that matter, the old
20 criterion of 25 system minutes?

21 A. These performance standards are the
22 standards used by the power system operations division,
23 who are --

24 Q. Excuse me, when you say "these," you
25 mean the standards on page 17?

1 A. On page 17, yes.

2 When these standards were developed,
3 which was in the early part of the 1980s, the basis
4 used was that system planning would provide us with a
5 system that had 25 system minutes of unreliability.

not sure
to have
energy if
public
appeals become
common
practice

6 But we were to measure all forms of unsupplied energy,
7 including such things as voltage reduction, public
8 appeals, and everything else, not just interruptions.

9 And it was deemed at that time that a
10 standard of 75 system minutes, that is, the part that
11 refers to generation facilities, would be a reasonable
12 standard to take account of all unreliability or all
13 generation facilities' unreliability.

14 Now, I should say that these standards
15 are the subject of review right now; in fact, this
16 report was the 1989 report. In the 1990 report, there
17 is no reference to these performance standards now.
18 These performance standards are being taken out,
19 because they are under review right now as to whether
20 they are still appropriate.

21 Q. When you say they are taken out, that
22 page is just removed from the report?

23 A. Yes.

24 Q. Is there anything to replace them?

25 A. They are currently being reviewed and

1 we hope that a new set of standards will be introduced
2 as soon as they can be developed.

3 Q. Is it fair to say that the new
4 standard will be, of necessity, somewhat higher than
5 the standard of 10 system minutes?

6 A. I think it probably will. The work
7 hasn't been done yet, but the work probably will, in
8 that we are taking account of, as I said, all forms
9 of unsupplied energy. What might be called a close
10 call, where we get by with simply doing a voltage
11 reduction - no one is interrupting - that still appears
12 in our measuring system. And so, obviously, the
13 standard should be higher for something that is
14 measuring all forms of unsupplied energy than if you
15 are only measuring interruptions.

16 So yes, the standard will likely be more
17 than 10.

18 Q. So, in effect, you have different
19 departments conducting different measurements and
20 including different things in the measurements, which
21 accounts for the difference between the two values of
22 system minutes; is that fair?

23 A. I think that's true, yes.

24 Q. And yours, of necessity, is more
25 all-encompassing, and as a result, it will be a higher

1 number?

2 A. Yes, we take account of more kinds of
3 unsupplied energy. Any kind of unsupplied energy will
4 appear against our performance measurement.

5 Q. Mr. Barrie, if I could just deal with
6 one other thing before we move on? Did I hear you to
7 say that, when you are describing the difference
8 between the two system minutes, you referred to voltage
9 reduction and appeals, and you said, for instance, you
10 would consider them for the, what was the 78 criteria,
11 78 system minute criteria, but as you understand, they
12 are not included in the 25 system minutes criteria?

13 A. I am not sure about that.

14 That is correct, I am told.

15 MR. TABOREK: A. In the calculations
16 done in 1981, they were not included as part --

17 THE CHAIRMAN: I can't hear you, Mr.
18 Taborek.

19 MR. TABOREK: Mr. Watson is correct. In
20 the calculations done in 1981, voltage reductions were
21 not included in the 25 system minutes.

22 MR. WATSON: Q. And I understand that
23 for the 1991 reliability review, which is Exhibit 87,
24 that voltage reductions and appeals are included in the
25 system minute calculation; is that correct?

1 MR. TABOREK: A. That's correct.

2 MR. SNELSON: A. There is another point
3 you should take into account here when you are trying
4 to make a parallel between a reliability calculation
5 that is done for the purposes of planning, with
6 prospective forecast data, and a reliability
7 measurement of actual performance.

8 As Mr. Barrie has said, the actual
9 performance will capture unreliability due to all
10 causes, no matter whether or not the generation
11 planning model actually includes that cause among the
12 phenomena modelled in the program.

13 Mr. Taborek, I believe yesterday, made a
14 point of saying that the model is an imprecise
15 reflection of (coughing) and only includes some, we
16 believe the most significant, but it includes some of
17 the effects that affect reliability. It doesn't
18 include all of the effects that affect reliability.

19 And any practical model is going to have
20 to exclude some real phenomena. The real world is too
21 complicated to put into a completed model in a computer
22 program.

23 Q. One final question, before we leave
24 that: If in fact, voltage reduction and appeals are
25 now in the reliability calculations for the 10 system

1 minutes, what are some of the examples of things that
2 are not included in the 10 system minutes that would be
3 included in what was formerly the 78 system minutes?

4 MR. BARRIE: A. Well, you should take
5 the 3 off straightaway. That is generation fuels.
6 Okay.

7 Q. Yes.

8 A. That means when we have to -- we
9 don't have enough fuel supplies at the generating
10 stations, although the facilities might be there, we
11 don't have the fuel to burn. So that there is some
12 unsupplied energy, but that is very small. That is
13 only 3. So it should be the 75.

14 Q. The oil shortage at Lennox is an
15 example of that?

16 A. That's right.

17 Q. Are there any other factors?

18 MR. SNELSON: A. If you refer to the
19 1981 report, which, I believe, we just gave an exhibit
20 number to.

21 MR. TABOREK: A. Is that 140, Report 603
22 SP.

23 MR. SNELSON: A. That would be Exhibit
24 140, Table 2-1, towards the back. I think it is about
25 3 pages in from the back of the report. That has a

1 list of features that might be included in reliability
2 models.

3 And the two columns of that Table 1, one
4 is entitled LOLP, which is the loss of load probability
5 model that preceded our frequency and duration model,
6 and is still used by many utilities. And the
7 right-hand column this the F&D, frequency and duration
8 model, which we currently use, with some modifications
9 in the recent review. And you will see there is a
10 column of yes's and no's, as to whether that factor is
11 included in the model.

12 And towards the bottom of the right-hand
13 column are a number of factors, such as uncertainties
14 in outage factors, common cause failures, malicious
15 damage, shortages of critical materials - and the
16 Lennox oil shortage would perhaps classify as a
17 shortage of critical materials - strikes, failure in
18 delivery of purchased firm power. Those are some
19 factors which are not included in the F&D model, as
20 presently structured -- well, as structured then, and
21 they are not included in the model as of today, either.

22 Q. One final question on this area. If
23 you refer to the reliability review for 1991, which is
24 Exhibit 87, at page 114, that's page 9 of Exhibit 137,
25 the load table. Below Table 6-10, the first sentence

1 reads, "A planning target of about 22 per cent would
2 allow an error of about 5 per cent without significant
3 use of emergency measures."

4 The criteria of 78 system minutes --
5 could you help us out as to whether that would entail
6 significant use of emergency measures by using that
7 reliability criteria?

8 MR. TABOREK: A. This particular table
9 is part of the calculation we did looking back at our
10 past experience, trying to determine what that would
11 suggest about a reserve margin for the future. And it
12 suggested 22 per cent.

13 Now, if you start with this 22 per cent,
14 we had noted that there was only a small use of
15 emergency measures at the 17 per cent level. There is
16 a table fairly close to this one, where the actual --
17 is it 170 hours and 2 per cent of the time or
18 something? It's a very small use of emergency
19 measures.

20 If you then took the next 5 per cent
21 slice, you would, by and large, be using reductions in
22 customer interruptible loads and emergency purchases on
23 the interconnections. And neither of those is counted
24 in system minutes.

25 If you took the next 5 per cent slice,

1 you would get into voltage reductions and public
2 appeals. And that would get you into system minutes,
3 that would be counted as part of whatever criteria you
4 were using. And then, of course, the final slice would
5 be load cuts.

6 Now, this particular form of analysis,
7 it's not conducive to taking these instances through
8 the year and converting them to system minutes. We
9 don't do that so I can't answer the detail of your
10 question.

11 Q. Is there anyone else who might be
12 able to assist with that question?

13 A. We hadn't done the calculation.

14 MR. WATSON: Mr. Chairman, I was
15 wondering if it would be possible to leave that
16 question with the panel, depending on how much work it
17 is. I don't want them to go out and remodel the
18 system, but if, in fact, they could deal with that
19 question in a summary form and perhaps get back to us
20 later, I would appreciate that.

21 MR. BARRIE: What is the question?

22 MR. TABOREK: Could you restate the
23 question, please?

24 MR. WATSON: I certainly will.

25 Q. If you look at page 114, the first

1 sentence talks about a planning target of 22 per cent,
2 which would allow an error of about 5 per cent without
3 a significant use of emergency measures.

4 And what I am concerned about is the
5 other criteria of 78 system minutes. And if, in fact,
6 we are dealing with that criteria, using what we have
7 heard from that sentence, aren't we into a situation
8 where we might have to have, shall we say, further use
9 of emergency measures?

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1 [11:05 a.m.] MR. TABOREK: A. Oh, well, maybe there
2 is a more direct approach to what you are suggesting
3 because the main thrust of this document, Exhibit 87,
4 is saying that the reserve margins in the range of 20
5 to 24 per cent are about right.

6 And we then go on and say that if you use
7 those reserve margins, your expected system minutes for
8 generation is, approximately, ten and that is due to
9 public appeals and voltage reductions and load cuts.

10 So, that the number, I guess, you are
11 looking -- a quick answer that you are looking for is
12 it would give you about ten system minutes.

13 MR. SNELSON: A. ...date to about ten
14 system minutes.

15 Q. So, if it is predicting ten system
16 minutes, then isn't the answer to the question, yes;
17 that there would be, using that criteria, increased
18 emergency actions used?

19 A. Any reduction in the reserve margin
20 is tending to increase the use of emergency actions.

21 MR. TABOREK: A. And it would use the --
22 okay...

23 MR. SNELSON: A. This is a very
24 difficult area of trying to make a correspondence
25 between a planning model that covers certain aspects of

1 unreliability that can be mathematically modeled, and
2 the actual operation in the real world situation where
3 there are many other effects that affect operation.

4 The precise lining up of a planning model
5 with actual experience or with actual operating
6 criteria is a very difficult task. This difficulty of
7 making this link is one of the reasons that this
8 business of reliability has a significant dose of
9 judgment in the way in which it is treated. And we
10 have looked at it from a number of directions, and we
11 believe that our 20 to 24 per cent is about the right
12 level.

13 Q. Thank you.

14 Is it fair to say that the new standard
15 of 10 minutes and the old standard of 25 minutes is, in
16 effect, an expected value, whereas the 78 system
17 minutes is a value which is put forward to accommodate
18 a number of situations which could occur?

19 MR. BARRIE: A. Well, let's put the 75
20 in some context here, can we?

21 Q. I will try and refer to 75. You keep
22 telling me to use 75.

23 A. Well, the three is specifically the
24 fuels, which is...

25 Q. Right.

1 A. The 75 is a standard that has been
2 used by the operations division, against which
3 generation facilities' performance is measured.
4 Whether it is an appropriate number or not has been
5 called into question considerably over the last year.
6 And as I did mention earlier, it is now not being used
7 by our division as a measurement.

8 It is very questionable whether that is
9 now an appropriate standard that we would be working
10 against. If you look at our actual performance, our
11 actual performance is considerably better than
12 standard. And one must ask, well, what impact has that
13 standard had on any decisions that we have had to take?

14 Operationally, it has had no significant
15 bearing on any decisions we have had to take. I'm
16 suggesting to you that we should downplay the 75 system
17 minutes, in that we are not using it now, and that our
18 actual performance has been considerably better than
19 that for the last ten years.

20 Q. I'd like to turn now to the
21 frequency...

22 THE CHAIRMAN: Can I ask a question? If
23 you say you are no longer using 75, what, if any, are
24 you using?

25 MR. BARRIE: We are continuing to monitor

1 our performance and measure it against -- we are really
2 looking now at trends, as to how we did compared to
3 last year.

4 THE CHAIRMAN: But you are not using a
5 specific number? You formerly used 75, and you are not
6 using a specific number now?

7 MR. BARRIE: That is correct. A new
8 number is being developed now.

9 THE CHAIRMAN: But, in the meantime, on a
10 day-to-day basis, where before you used 75, you are not
11 using any number?

12 MR. BARRIE: I think the point I was
13 trying to make, on a day-to-day basis, this standard
14 does not have a great bearing on our day-to-day
15 operating activities.

16 THE CHAIRMAN: I understand that. But
17 before you used 75, now you use nothing, is that right?

18 MR. BARRIE: There is no standard
19 established right at this point in time, yes.

20 THE CHAIRMAN: All right, okay.

21 MR. WATSON: Q. Panel, I'd like to turn
22 to the F&D model. I have a few introductory questions.
23 And then, I'm going to be turning to other topics, but
24 the F&D model will come up through those other topics,
25 as well.

1 Just by way of introduction, could you
2 tell us what the F&D model is used for? What all of
3 its uses are? Mr. Taborek, perhaps you are the one to
4 answer this question.

5 MR. TABOREK: A. All of its uses. It is
6 used for predicting the amount of unsupplied energy
7 that results under various circumstances involving load
8 and generation uncertainties which we have defined on
9 our generating system.

10 Q. Is that it?

11 A. That is it.

12 Q. Thank you.

13 F&D is → Is it different from reliability models
14 used by other utilities?

15 A. Well, there are quite a number of
16 reliability models that other utilities will use.
17 Quite a number of utilities use loss of load
18 probability models, so-called LOLP approaches. Other
19 utilities use -- oh, and LOLP, as I defined, is the
20 expectation that you will not be able to meet a peak.
21 And it is usually expressed one in twenty-four hundred,
22 or one day in ten years, to have a little more popular
23 number associated with it. That is often used.

24 Other utilities don't use LOLP which is
25 just the probability or an expectation. They will use

1 unsupplied energy and they can calculate them with
2 different models. There are utilities, frequently,
3 develop models of their own or use other models.

4 Q. Does Hydro use any other generation
5 reliability models?

6 A. No, F&D is our -- from time to time,
7 we have used others for special various purposes, but
8 no, F&D is our standard model, I think.

9 Q. Was F&D developed at Hydro?

10 A. Yes, it was.

11 MR. SNELSON: A. Perhaps I could just
12 add to that. F&D model was originally developed by
13 Professor Billinton at the University of Saskatchewan,
14 and it was further developed inside Hydro to make it
15 reflect, specifically, Ontario Hydro's circumstances.

16 MR. TABOREK: A. A more precise...

17 MR. SNELSON: A. So, the theory and the
18 original code was developed outside of Hydro, but the
19 customizing of it, to Ontario Hydro's situation, was
20 within Hydro and was done in the mid 1970s.

21 Q. Do you know if F&D is used at any
22 other utilities?

23 A. I couldn't quote another utility,
24 specifically, that used it. It is a well-known method
25 that is reported in the literature. And one reference

1 to it is Professor Billinton's book, but there are
2 others.

3 Q. Do you use the Procose model? That
4 is P-r-o-c-o-s-e.

5 A. We have that available within system
6 planning division, and it is used from time to time for
7 specialized studies of the interaction between
8 generation and transmission problems. It is,
9 generally, not a sufficiently amenable model to be used
10 for generation/reliability studies, as a normal tool.

11 Q. I assume that would be the main
12 difference between it and F&D?

13 A. The mechanics of the two programs are
14 very different. The difference we have described is
15 more in their use than their mechanics.

16 Q. So, there are a series of differences
17 then; the mechanics, the use. They are just different
18 models doing different things?

19 A. Yes.

20 Q. Did Procose have any role in the DSP?

21 A. Not to my knowledge.

22 Q. Has the F&D model been validated for
23 Hydro's system?

24 MR. TABOREK: A. I think the validation
25 is reported in Exhibit 87.

1 Q. Do you have a page?

2 A. The entire report is focused on...

3 To elaborate, the F&D model was originally used in the
4 analysis by which we went through the process of going
5 from reserve margin, to unsupplied energy, to total
6 customer costs. And we arrived at, early in the 1980s,
7 the 25 system minute criteria and we used that to get
8 reserve margins in the range of 22 to 24 per cent.

9 The purpose of having done that, using
10 F&D and judgment, we then said, "How do we know that
11 those results are reasonable?"

12 And we then conducted the review, and the
13 review, the validation, took three parts: One,
14 comparing ourselves with the results that other
15 utilities were getting; two, looking at reserve margins
16 that would come out of a review of our past experience,
17 and whether we were perhaps a bit high or a bit low;
18 and then finally, I guess you would call, a review of
19 all the assumptions that went into F&D, and
20 improvements in certain aspects of the model.

21 The results of all of those tended to
22 confirm that the reserve margins were about right, but
23 the system minutes were different. And that the
24 outcome of that, I would say, is a validation of F&D
25 against experience and other utilities and an appraisal

1 of models.

2 Q. The F&D model was created in the late
3 '70s, I believe. 1977, is that correct?

4 A. Ken said, mid-'70s.

5 MR. SNELSON: A. My recollection is
6 mid-'70s, but I couldn't give you a precise year.

7 Q. Thank you. That is fine.

8 Mr. Taborek, you were saying that, in
9 effect, Exhibit 87 is the validation of the model.
10 That is a 1991 report. Was there any validation
11 between the mid-'70s and 1991?

12 A. Mr. Taborek did earlier refer to the
13 references to the 1981 report which I believe has been
14 given the number Exhibit 140, and referenced, too, was
15 some work by Mr. North within Hydro, and that is on
16 page 26 of that exhibit.

17 Q. Item No. 2 under heading 8
18 "References"; is that correct, Mr. Snelson?

19 A. That is correct.

20 Q. Could we get a copy of that sometime?
21 There is no rush. We don't need it right now, but
22 perhaps tonight?

23 A. We will look for it. Whether we will
24 find it or not, I'm not sure. You are talking about
25 very old materials here, and this is an internal

1 memorandum, not a formal report. So, it may or may not
2 be findable.

3 Q. I know you will do your best.

4 MR. TABOREK: A. Another aspect, if I
5 may? There is another form of indirect validation that
6 happens fairly continuously.

7 The F&D model ultimately produces a
8 reserve margin, and that reserve margin is produced,
9 approximately, every year for planning studies that are
10 done using the 25 system minute criteria, and using the
11 latest assumptions pertinent at the time.

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1 [11:20 a.m.] And if you begin to get answers that your
2 reserve margins are beginning to be different than
3 other people's, or changing, you begin to wonder, you
4 have to to go back and track down and explain these
5 differences. So there is this series of judgments made
6 every time you use the model to whether it seems to be
7 behaving properly.

8 Q. Still talking about validation, was a
9 historical year used to validate this in any way?

10 A. Now what validation are you referring
11 to? The validation we did, where we looked at history,
12 as reported in Exhibit 87, we looked at the operating
13 years '85 to '89.

14 Q. And you took the actual data that you
15 had for those years and used it to validate the model
16 over that period?

17 A. Well, to validate, I think when you
18 use the word "validate," you are implying more in the
19 nature of the one-to-one comparison of various items in
20 the model against the operating year. That's not what
21 was done. What was done was to compare the end result
22 of the two.

23 Q. And the end result is the reserve
24 margin?

25 A. And the end result is the reserve

1 margin. In the case of our analysis of our operating
2 experience, we said it gave the number of 22 per cent.
3 When we did the analysis again, using the updated F&D,
4 and the latest data, we got a range of 20 to 22 per
5 cent.

6 THE CHAIRMAN: I'm sorry, I didn't hear
7 that.

8 MR. TABOREK: When we did the analysis
9 with our updated information and the improved model, we
10 got a range of 20 to 22 per cent for the reserve
11 margin, that gave minimum total customer cost. And
12 that compared with 22 per cent for the appraisal we
13 made of our operating experience. And so we were
14 pleased that they seemed to be in correlation.

15 And again, just to mention, we also did
16 an appraisal and said, what would utilities, or what do
17 utilities with similar characteristics to us seem to be
18 doing? And they seem to be averaging about 21 per
19 cent. So we had these three cross-checks, if you will,
20 of the results of the processes and they were quite
21 close together.

22 MR. WATSON: Q. Is it fair to say that
23 the F&D model produces a series of outputs as you go
24 along. And at the end of the day, it produces the
25 reserve margin figure. You didn't check the series of

1 numbers that the model produces along the way, but you
2 looked at the final number, the reserve margin, and
3 that's where you did your validation, if you will?

4 MR. SNELSON: A. Let's be quite clear.
5 The F&D model does not produce reserve margin. The F&D
6 model takes a given system with certain
7 characteristics, and a given load with certain
8 characteristics, and uncertainties of both, and models
9 those uncertainties and predicts the number of system
10 minutes of unsupplied energy, or the unsupplied energy
11 in megawatthours, actually. The division by peak load
12 is outside of the model, I believe.

13 So the process of determining a reserve
14 criteria is through repeated use of the F&D model with
15 different levels of reserve, and calculating the system
16 minutes and doing some economic calculations based on
17 that, as Mr. Taborek described. So it's not a once
18 through the model to produce an optimal reserve level.

19 MR. TABOREK: A. This is the process I
20 described using this page from Exhibit 136 yesterday,
21 where you begin with adding resources to the system or
22 defining a set of resources on a system. A fairly
23 simple calculation gives you reserve margin. And so
24 you note that reserve margin, in effect.

25 But now these resources are used to

- 1 ① compute the unsupplied system minutes. And then, you
2 take the unsupplied system minutes and add customer
3 ② damage cost to define the customer interruption costs.
4 ③ You take the resources you have added to the system and
5 they define the cost of supply, and they give a total
6 = 4 customer cost.

7 So, when you go through this, you will
8 have noted a reserve margin; you will have computed an
9 unsupplied system minutes, which you will note, that
10 corresponds to the reserve margin and the total
11 customer cost.

12 As Ken was saying, you go back and you
13 change the balance of resources to give a range of
14 customer costs, and you look for the minimum. And at
15 the minimum, you note the corresponding unsupplied
16 energy and the corresponding system reserve margin, and
17 that's the number we are reporting, that which
18 corresponds to the minimum.

19 This is, to tell you how you know you are
20 at the right level of reliability, this parameter tells
21 you what the reliability is at the level and this is
22 what describes the system margins at that level.

23 Q. If you could leave that up, please, I
24 may like to refer to it in a few minutes. So the F&D
25 model is only used in the third box on that chart?

1 A. To produce the unsupplied energy,
2 that's correct.

3 Q. The title page of the F&D model uses
4 as the term "two state." Does that imply that a
5 generation unit is models having only two possible
6 availability states, either available at full capacity
7 or not available at all?

8 MR. SNELSON: A. I believe that's
9 correct, yes.

10 Q. I understand it is possible to have
11 more detailed models with additional states.

12 A. That is correct.

13 MR. TABOREK: A. Yes.

14 Q. And these additional states can
15 represent, for instance, partial availability levels.

16 A. That's correct.

17 Q. And if this other model, with more
18 availability states, was compared to the F&D model,
19 with only two states, is it fair to say that the
20 two-state model could overstate the unreliability of
21 the system?

22 A. I think, not by a significant amount.

23 We were aware that, analytically,
24 multi-state models give more detail than dual state
25 models. When we considered the improvements to be made

1 to the model, we gave some thought to that, but didn't
2 feel it gave a significant improvement and that we
3 would be far better off, in describing our system, to
4 concentrate on the description of the hydraulic energy
5 limits.

6 Q. Was that a judgment call that you
7 made?

8 A. Yes, yes.

9 Q. Can you give us some idea of what a
10 significant difference is? You said it wouldn't make a
11 significant difference.

12 MR. SNELSON: A. I don't think we can
13 give a numerical estimate, but we would expect it to be
14 quite small on our system, because the effect you are
15 describing tends to be significant on systems with very
16 few large generating units, where the unit size is a
17 significant proportion of the total system size.

18 And it is different, the effect on the
19 system is different, between having a unit at half
20 output for two hours, compared to having a unit at full
21 output for one hour and zero output for another hour.
22 And on a small system, where unit size is significant
23 portion of system size, say, if the unit size is of the
24 order of 5 or 10 per cent of system size or greater,
25 then that effect could be significant. But on a system

1 such as ours, where unit size is, at most, around 3 per
2 cent of system size, then this is a very small effect.

3 Q. Have you done any analysis of that
4 theory? Are there any studies?

5 A. Not in recent years, but it was
6 certainly looked at 10, 15 years ago when the system
7 was reaching this sort of unit size.

8 MR. WATSON: Mr. Chairman, I was about to
9 turn into another area, if now would be an appropriate
10 time for the break.

11 THE CHAIRMAN: Thank you.

12 THE REGISTRAR: The hearing will recess
13 for minutes.

14 ---Recess at 11:30 a.m.

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1 ---On resuming at 11:37 a.m.

2 THE REGISTRAR: Please come to order.

3 This hearing is again in session. Please be seated.

4 THE CHAIRMAN: Mr. Watson.

5 MR. WATSON: Q. Panel, if you could turn
6 to page 10 of Exhibit 137. That's Figure 5.1 of
7 Exhibit 87.

8 THE CHAIRMAN: Go ahead.

9 MR. WATSON: Q. Just a point of
10 clarification, before we talk about the figure. I
11 understand that Figures 5.1, 5.2, and 5.3 have been
12 revised?

13 MR. TABOREK: A. That is correct.

14 Q. Each of those figures have, in
15 effect, two graphs per figure: one dealing with the
16 year 2000/2001; the other dealing with the year
17 2005/2006. And the changes for all three graphs are
18 reflected in the year 2005/2006; is that correct?

19 A. Yes.

20 Q. Now, very briefly, with respect to
21 Figure 5.1, just by way of overview, this figure seems
22 to illustrate the fundamental concept behind setting
23 the target reserve margin?

24 A. Not quite.

25 Q. No?

1 A. What it illustrates is how to
2 determine where the minimum total customer cost is;
3 that going from there to setting the reserve margin,
4 then involves a series of judgments which I explained
5 in my direct evidence yesterday.

6 Q. Is it fair to say that the target
7 reserve margin for a given set of assumptions, looking
8 at this curve, should be the value at which the
9 reliability benefits of adding a CTU equal the cost?

10 A. Yes, but again, that's where the
11 minimum number total customer cost occurs, at that
12 point.

13 Q. Yes. And looking at this Figure 5.1,
14 that point occurs where the curves cross the horizontal
15 line which is labelled "Cost of Adding a CTU"?

16 A. That's correct.

17 Q. And for the monthly curve on Figure
18 5.1, this occurs at about 20.5 per cent?

19 A. For the year 2000/2001, that's
20 correct.

21 Q. Yes.

22 And as you said, the basis of this
23 calculation is a minimization of total customer costs,
24 including both supply costs and customer interruption
25 costs?

1 A. That is correct, with one slight
2 variation.

3 I showed you yesterday a curve which had
4 all of the information you described, or a sample of
5 that kind of curve. And that curve that I showed you
6 yesterday had a broad, flat bottom. And it's very
7 difficult to pick out the precise optimum.

8 So, these curves are, in effect, the
9 derivatives, to be technical, of the previous curves.
10 They give the increments in system cost and the
11 increments in reliability; the benefits of reliability.
12 So as you can see, these give a very sharp indication
13 of where the optimum -- where the minimum total
14 customer cost occurs.

15 So with just that slight variation on
16 what you say, that is why these curves are slightly
17 different than the ones I showed you yesterday.

18 Q. You said derivative. That is the
19 first derivative--

20 A. The slope.

21 Q. --so in effect these slopes are the
22 slope of the other curves?

23 A. That's correct.

24 The reason for doing it this way, just to
25 explain, is that the first calculation is very, very

1 lengthy. You have to look at the whole system and
2 optimize the whole system. With this, you just look at
3 what is changed. And it is particularly appropriate,
4 since CTUs are the appropriate mechanism to add for
5 peaking and for reliability, so it permits the
6 short-cut to a sharper answer. That's why we did it
7 this way.

8 Q. Before we broke, you had a slide on
9 the overhead. If you wouldn't mind putting that back
10 on, please? That's the one. Thank you.

11 Now, I would like to talk a little bit
12 more in depth about what, in fact, the F&D model does,
13 and how it ties in with the overall system of
14 calculating the reserve margin.

15 I understand the F&D model does not
16 produce the curve at Figure 5.1; that is not an output
17 from the F&D model?

18 A. What the F&D will produce is
19 unsupplied energy, which will contribute to the curve
20 on the left, the sloping/declining curves, the sloping
21 curves on the left, labelled "daily" and "monthly." It
22 is multiplying the unsupplied energy from an F&D run,
23 which gives you the worth to the customer. And then we
24 do two runs and get the differential, and that is what
25 is recorded on this curve. So F&D contributes to those

1 sloping lines. It's giving the improvement in
2 reliability, by adding more and more reserve to the
3 system.

4 Q. So it contributes to the curve. So
5 you have the F&D model producing its contribution and
6 then there is some manual process, and then the curve
7 at Figure 5.1 is produced?

8 A. Manual process... Well, we run F&D
9 to produce an unsupplied amount of energy for a
10 particular configuration. We then add four combustion
11 turbine units which have about 672 megawatts. Now, why
12 four? Why 672? It gives about a 2 per cent
13 improvement in reliability margin.

14 So we re-run again, with the 2 per cent
15 higher margin, say, with the CTUs added, and naturally
16 you get an improved amount of unsupplied energy. We
17 then take the difference, the improvement in unsupplied
18 energy, the difference, so now we are getting to the
19 slope, multiply that by the value to the customer of
20 that amount of unsupplied energy, and that's what is
21 plotted in the sloping lines.

22 And then, the horizontal line is taking
23 the cost of adding the four CTUs to the system and
24 repeating the calculation until you define the curves.
25 Or we do it with an additional four CTUs, an additional

1 four CTUs, an additional four CTUs, and show the
2 benefit of adding CTUs.

3 DR. CONNELL: Amortized over what period?

4 MR. TABOREK: Amortized over the life of
5 the CTUs, yes, with a real discount rate of 5 per cent.

6 MR. SNELSON: The methods of amortizing,
7 or levelizing, costs will be discussed in some detail
8 in the next panel, in Panel 3.

9 MR. WATSON: Q. If you could turn to the
10 1981 reliability study, Table 2, which is at page 11 of
11 Exhibit 137?

12 THE CHAIRMAN: Did you say 1982?

13 MR. WATSON: The 1981 reliability study--

14 MR. TABOREK: It is Exhibit 140.

15 MR. WATSON: --which is Exhibit 140. But
16 the table that I am referring to is at page 11 of
17 Exhibit 137.

18 THE CHAIRMAN: I have that, thanks.

19 MR. WATSON: Q. That is Table 2 labelled
20 "System Designed on 25 System Minute Criteria.
21 Occurrence of Load Cuts and Operating Actions." Could
22 you tell me whether this table, these values, are
23 obtained from the F&D model?

24 MR. TABOREK: A. Yes.

25 Q. Are these values taken from output

1 tables produced by F&D?

2 A. I would presume, so. I don't have
3 personal experience with the output of this, but yes.

4 MR. SNELSON: A. I perhaps have a little
5 more in that I can remember some of the things that
6 happened when this was done.

7 And these would be interpolations from
8 the tables that are output by F&D. So F&D would have
9 outputs at different levels in megawatts, which may or
10 may not correspond to exactly the levels at which these
11 control actions that are shown on the left-hand side
12 would occur. So there would be interpolations
13 required. But essentially, this information is
14 produced by F&D.

15 Q. Since F&D was brought in in the
16 mid-'70s, have any additional fields or output tables
17 been put into it by Hydro?

18 MR. TABOREK: A. I am sure there would
19 be, especially in dealing with the energy limited
20 hydraulic, but I am afraid I can't -- well, I should,
21 just right up, I can't answer that exactly, but I am
22 sure there would be.

23 We do make evolution to the model over
24 time. I know there had been deletions, and I am sure
25 there have been additions. I can't give you a list.

1 Q. Mr. Snelson, you are mentioning

2 = interpolation. If you can turn to the next page of
3 Exhibit 137, that is page 12. And perhaps at this
4 point, I could make the actual F&D manual an exhibit?

5 THE REGISTRAR: 141, Mr. Chairman.

6 THE CHAIRMAN: Thank you.

7 ---EXHIBIT NO. 141: F&D Manual.

8 THE CHAIRMAN: This is taken from 141, is
9 it?

10 MR. WATSON: It is. This is table 9.4 of
11 Exhibit 141.

12 MR. SNELSON: Perhaps we could have a
13 copy to look at?

14 MS. PATTERSON: Mr. Watson, what year is
15 this? It is sort of illegible.

16 MR. WATSON: It looks as though it is run
17 from 1977. Mr. Snelson might be able to help us out a
18 little bit more on that.

19 Q. Is that fair, Mr. Snelson?

20 MR. SNELSON: A. You are getting to a
21 level of detail in some of these tables which I don't
22 think either Mr. Taborek or myself can guarantee that
23 we can answer your questions. We will listen to the
24 question and, if it's within our knowledge, we will try
25 and answer. Otherwise, I am afraid we will not be able

1 to help you.

2 MR. WATSON: Ms. Patterson, in trying to
3 answer your question, I looked at the top of Table 9.4
4 in the right-hand column. The date looks like 07 23 77
5 maybe.

6 MS. PATTERSON: But it says in the
7 left-hand side, frequency and duration study for the
8 year nineteen eighty... It looks like...

9 MR. SNELSON: It does look as though the
10 run was on the 23rd of the seventh month of 1977.

11 MR. WATSON: And they are doing some
12 predictions for the years up to 1983, perhaps.

13 MR. SNELSON: That's what I would judge
14 from the table. I am not sure I have seen this before.

15 MR. TABOREK: These are calculations to
16 illustrate the manual on how to use the 1977 version of
17 the program.

18 MR. WATSON: Q. As I understand from
19 Mrs. Formusa that this was the answer to an
20 interrogatory, interrogatory 2.14.29.

21 MR. SNELSON: A. That's correct.

22 Q. You are saying this is an old manual.
23 Is there another manual around?

24 MR. TABOREK: A. No, there isn't.

25 Q. So this is it?

1 A. We haven't updated the manual, that's
2 correct.

3 Q. So there is nothing else we can work
4 with. We have to work with this.

5 A. Well, you have us. (Laughter) A poor
6 second.

7 Q. Mr. Snelson, looking down near the
8 bottom, there is a series of figures running across the
9 page, margin interval from 2. The first column looks
10 like 463 and it goes to 0, and then down. The second
11 column starts at 0 and then goes down. Do you have
12 that?

13 MR. SNELSON: A. Yes.

14 Q. Were those the figures you were
15 talking about interpolating?

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1 [12:04 p.m.] A. I was talking about interpolating a
2 table that would have been this form. I'm sure it
3 wouldn't have been these numbers.

4 Q. But the tables in this area, the
5 numbers in this area, the margin numbers, the duration
6 numbers, the energy numbers, those are the things you
7 were talking about?

8 MR. TABOREK: A. Yes. The different
9 levels by which you -- if you are looking at the margin
10 interval from and to, you can structure that in such a
11 way that it reflects the emergency measures that you
12 have. So the number of times that you are in a certain
13 region indicates the use of the emergency measures in
14 that region.

15 Q. Looking at that table, you have
16 values for duration, energy not supplied, a number of
17 other columns, rotating cuts. Can you tell us which of
18 those values are used in coming up with the actual
19 reserve margin?

20 A. The unsupplied energy.

21 Q. Just the unsupplied energy?

22 A. Yes. We tend not to -- latterly, we
23 have not been using the frequency and duration numbers.
24 We have been working with unsupplied energy.

25 Q. Are the frequency and duration

1 numbers there used for any other purpose?

2 A. No, not that I am aware of; no.

3 Q. If we could turn back to page 11,
4 please, of Exhibit 137? That is table 2.

5 A. The table 2 showing system minutes
6 of outages and different -- yes.

7 Q. Yes. There are three columns;
8 frequency, duration and unsupplied energy.

9 A. Yes.

10 Q. If I can refer you to the unsupplied
11 energy column, are any values, other than unsupplied
12 energy for rotating load cuts, used in deriving figure
13 5.1?

14 A. No, it is only the rotating load cuts
15 that have costs associated with them.

16 Q. So the answer to the question is
17 because they are the only ones with costs associated
18 with them, they are the only ones that go into the
19 calculation of the figure 5.1?

20 A. Yes.

21 Q. In dealing with unsupplied energy, I
22 notice that there are two columns, average width
23 uncertainty and average no uncertainty. I assume you
24 used the average width uncertainty values?

25 A. Yes. This is a 1981 analysis, we are

1 referring to with this table.

2 Q. Yes.

3 A. And the answer is yes with respect to
4 that.

5 Q. Well, dealing with 1991...

6 A. Yes, it is true. I didn't mean to
7 try to hedge or dodge. We similarly use average with
8 uncertainty, counting rotating load cuts now, too.

9 Q. All right, so while this is an '81
10 table, the method is the same.

11 A. Yes. I didn't want to give the
12 impression that this table was a current table. It is
13 a decade old.

14 Q. Oh, yes, no question. But the theory
15 is the same?

16 A. Yes.

17 Q. Thank you.

18 Now again looking at unsupplied energy, I
19 notice that, while you have a value for rotating load
20 cuts at the bottom of the table, and then looking up,
21 you have a value for industrial and public appeals, you
22 have no value for voltage reductions. Does Hydro use
23 an estimate for unsupplied energy for voltage
24 reductions, or is that just not dealt with?

25 A. This was -- the calculation at the

1 time did not count, and Mr. Barrie made this point
2 earlier, this 1981 calculation did not count unsupplied
3 energy due to voltage reductions.

4 MR. SNELSON: A. The reason it was
5 excluded from this table, and, again, I'm stretching my
6 memory a long way back, is that we did not want to
7 imply that any energy reductions, or any energy changes
8 due to managed loads, which is load shifting in our
9 current terminology, or interruptible loads, that they
10 were unsupplied energy. Those are normal operating
11 actions, which we don't consider to be unsupplied
12 energy, so we didn't report anything in those columns.

13 THE CHAIRMAN: But I'm not sure why you
14 didn't include voltage reduction.

15 MR. TABOREK: Because it was, basically,
16 not evident to the public.

17 MR. SNELSON: There is a real difference
18 of opinion among different groups within Hydro, as to
19 whether you should or should not include voltage
20 reductions. It is a less than 100 per cent supply of
21 electricity that is demanded by our customers, and so,
22 in that sense, it could be counted as unsupplied
23 energy, and the operating branch clearly does count it
24 as unsupplied energy.

25 We didn't count it, because it is,

1 generally, almost imperceptible to customers. And that
2 is true of most customers, but not all customers.

3 DR. CONNELL: How is it achieved by the
4 way? Is this simply a manipulation of transformers
5 centrally.

6 MR. BARRIE: Yes. Essentially what
7 happens is at the bulk supply points, there is
8 transformation there, and there is, in fact, automatic
9 voltage control there.

10 A signal is sent, which essentially
11 depresses the low voltage side of the bulk supply at
12 the bulk supply point. It doesn't affect the high
13 voltage side, but it does depress the low voltage side
14 of the bulk supply point.

15 DR. CONNELL: Is it continuous or
16 step-wise?

17 MR. BARRIE: There are two stages that
18 can be applied, three per cent and five per cent
19 voltage reduction. As Mr. Snelson said, three per cent
20 is -- it would be very difficult to even notice it. At
21 five per cent, it does become more noticeable to
22 customers, especially those that have more sensitive
23 equipment.

24 DR. CONNELL: And it is uniform, then,
25 across the whole system?

1 MR. BARRIE: We can apply it wherever we
2 want.

3 DR. CONNELL: I see.

4 MR. BARRIE: We sometimes have instances
5 where we want it applied at a particular area, because
6 we might have some transmission problem. But in these
7 cases, I think we are talking about it being across the
8 province. If it is a generation shortfall everywhere,
9 it would tend to be across the province.

10 MR. TABOREK: In the 1991 analysis
11 recorded in Exhibit 87, we count voltage reductions in
12 the unsupplied energy, but we don't cost them, because
13 there is growing -- we have a good deal of evidence of
14 complaints from customers, and having to restore the
15 voltage to customers, because of equipment not
16 operating. So we now feel it appropriate to count.

17 So what you are seeing is a transition
18 over time. Some of the early analyses didn't, and then
19 PSOD did their analyses. In the mid-'80s, they began
20 to incorporate it into their criteria. We are now
21 incorporating it and now counting it, in our latest
22 analyses.

23 In Exhibit 87, there is a table which
24 lists the kinds of complaints, and it discusses our
25 rationale with respect to the counting of voltage

1 reductions. I just can't put my finger on it at the
2 moment.

3 MR. WATSON: Q. We will be referring to
4 it later.

5 MR. TABOREK: A. Okay.

6 Q. Could you tell us how many runs of
7 the F&D model are necessary to obtain the data you need
8 to produce figure 5.1?

9 A. No, I can't. Would you like to make
10 a stab at it, Ken? No; sorry.

11 Q. Rough guess? One, ten, a hundred?

12 A. Well, ten is closer than one or a
13 hundred.

14 Q. And each time you do an iteration, = repetition
15 you get some data, then you work with that data in that
16 context of the graph, or the flow chart that you have
17 on the overhead, and at the end of the day, after you
18 have done the iterations and extracted the data at each
19 iteration, done the manual computations, you arrive at
20 a curve?

21 A. Yes.

22 Q. Dealing with the unsupplied energy
23 numbers, how were they used to derive the curves in
24 figure 5.1?

25 A. Are you referring to an exhibit here,

1 or is the question in general? Are you referring to a
2 table or...

3 Q. Table 2.

4 A. Well, these are the 1981
5 calculations -- could you repeat the question again, to
6 make sure I understand it?

7 Q. Sure. How are those unsupplied
8 energy numbers used to derive the curves in figure 5.1?

9 A. Well, by using this process, and in
10 1981, the equivalent of what you are seeing in 5.1,
11 but -- not the differential curves that are in 5.1, but
12 the absolute curves.

13 Q. Perhaps I could help.

14 MR. SNELSON: A. Figure 2-6.

15 MR. TABOREK: A. Okay.

16 Q. Perhaps I could help you out.
17 Referring back to what I was saying a few minutes ago,
18 these are output numbers from the model. These are
19 used in your manual calculations, and from there, you
20 derive the curve?

21 A. Yes.

22 Q. Thank you.

23 Now if I defined for you something that I
24 would call marginal unsupplied energy, and let me give
25 that the following definition: The incremental

1 reduction in unsupplied energy, resulting from having
2 an additional kilowatt or per cent of reserve margin.

3 A. You say, if you could find that?

4 Q. I have set up that term, and that is
5 the definition that I have assigned to it.

6 A. Oh, okay. Say the definition again,
7 please?

8 Q. I will be pleased to repeat it.

9 Marginal unsupplied energy: The incremental reduction
10 in unsupplied energy, resulting from having an
11 additional kilowatt or per cent of reserve margin.

12 A. Okay.

13 Q. Are you comfortable with that?

14 A. Yes.

15 Q. Okay.

16 THE CHAIRMAN: Kilowatt or per cent the
17 same thing? There are two concepts there.

18 MR. WATSON: No. Kilowatt is a...

19 THE CHAIRMAN: I understand that, but I
20 mean, I think you are giving him two concepts--

21 MR. TABOREK: Giving me two numbers, yes.

22 THE CHAIRMAN: --of a definition.

23 MR. TABOREK: One in which you divide the
24 incremental unsupplied energy by a kilowatt, the other
25 in which you divide it by a reserve margin.

1 MR. SNELSON: You have a choice.

2 MR. WATSON: Q. You have a choice.

3 MR. TABOREK: A. Oh, okay. Curtain B.

4 Q. Does the F&D model calculate this
5 type of a parameter, or something like it?

6 A. Well, it will certainly do so by two
7 runs of F&D. The way that I would normally do it is,
8 and as I have described we have done it, is we would
9 add a kilowatt, or we would add some reserve margins,
10 and then you would get it.

11 Does the table...

12 MR. SNELSON: A. The margin table that
13 you were looking at, which is figure 12 of Exhibit 137,
14 comes close to that, but is not that.

15 Q. Could you help me out a little bit
16 about where it does come close?

17 A. As I understand the table, that was
18 about a third of the way down the page, that talks
19 about cumulative margin states.

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1 [12:20 p.m.] Q. Yes?

2 A. I believe that is the total
3 statistics. At zero is the state where load and
4 capacity are exactly in balance. And minus 625 is
5 where there is 625 megawatts of deficiency in capacity.
6 Minus 972 is where there is 972 megawatts of deficiency
7 in capacity, and so on.

8 So these are levels of deficiency. And
9 at those levels, then the columns give the statistics
10 as to numbers of outages, the average duration and the
11 energy not supplied at those levels.

12 Now, I believe that the next table is the
13 differentials, and is the differences between those
14 lines, and I would have to check the arithmetic to see
15 whether that, in fact, is the case, but I believe that
16 is that case.

17 And so, the zero to minus 625 line, in
18 the table that has the heading "Discrete Margins" gives
19 the average duration of being within that band of
20 deficiency and the energy not supplied that is
21 associated with being in that band of deficiency.

22 And so, these are close to incremental
23 values, but they are not due to a per cent of reserve
24 and they are not due to a megawatt of capacity, because
25 this is due to, in this case, a 625 megawatt change

1 that is there all the time.

2 When you are talking about the effect of
3 a change in load, then there are all the effects of
4 load shape that are modelled in the model which are not
5 captured in this table. So, if there was a 625
6 megawatts higher peak load, which would cause a 625
7 megawatts deficiency at the time of peak, then the
8 deficiency at other times will be less than 625
9 megawatts. So you would get a different result in the
10 calculation. Maybe not a very large difference, but
11 you would get a difference.

12 Similarly, the effect of 625 megawatts of
13 extra capacity would be different because that capacity
14 would have modelled with it its forced outage rates and
15 other characteristics of that capacity. So these types
16 of tables are indications of the sort of incremental
17 ideas that you are looking for, but they are not either
18 of the definitions you have given us.

19 Q. Are there any tables elsewhere that
20 would provide that sort of information, or is this as
21 close as we come?

22 A. I believe that the way Mr. Taborek
23 has said they had been doing the calculation is by
24 successive runs. Where they do, if they want to know
25 what an incremental change is, then they do a run; they

1 make a change to the load or to the capacity, and then
2 they do another run. And then, they look at the
3 difference in the final outputs.

4 Q. So the only variation is the CTU ?
5 block, in effect?

6 A. Yes.

7 Q. Just so I understand, the marginal
8 value you are calculating is in effect the marginal
9 value associated with the CTU block and not the
10 marginal value associated with a kilowatt or a per cent
11 of reserve margin; is that fair?

12 MR. TABOREK: A. Yes.

13 Q. If you could turn to the '91
14 reliability review, Exhibit 87, at page 95, which is
15 page 13 of exhibit 137.

16 Near the top of the page, the last
17 sentence before item 5.1.1 indicates that the higher
18 reserve margin requirement in 2005 relative to 2000
19 appears to be attributed to immature nuclear units and
20 peaking hydraulic additions.

21 Are there any other important causes?

22 A. No, those are the important causes.

23 Q. Can you tell us the relative shares
24 of these two causes, with respect to the total
25 increased reserve margin?

1 A. No, I can't.

2 Q. Can you give us a rough idea, as to
3 which one is larger?

4 A. No.

5 Q. Okay. Can you find out for us?

6 A. Yes.

7 Q. Thank you.

8 I understand that the commissioning a new
9 unit is, hopefully, a short-term phenomenon. Does the
10 required reserve margin spike up from the years
11 2004/2005 to the year 2005/2006, and then go down again
12 later?

13 A. That will depend if that is the end
14 of these phenomena. If you are, however, in a series
15 of additions of new units, you will go through the
16 teething problems with each of the new units and the
17 level will stay up. And it is when you stop putting
18 new units, that all of the immaturity is taken out of
19 the system. And when you are working with mature
20 units, it would drop again.

21 Q. In the plan, are there immature units
22 that are being added throughout the later parts of the
23 planning period?

24 A. Yes. The whole plan is to add units
25 and we attribute immaturity to all the units.

1 Q. So, in effect, what you are saying
2 is, as these new units are brought on, they are going
3 to have, as you said, teething problems as well.

4 A. Yes.

5 Q. So that we are not going to
6 experience a spike at that year, at 2005?

7 A. No.

8 Q. Are new units which are undergoing
9 commissioning counted as firm resources in determining
10 the forecast reserve margin?

11 MR. SNELSON: A. I think we can give you
12 how they are modelled, and you can determine whether it
13 meets your definition of firm.

14 There are two effects which are put into
15 the model to include the effect of immaturity. The
16 first effect is in-service date uncertainty. And I
17 believe that the model presumes that a generating unit
18 has a small probability of being six months early and a
19 small probability of being up to 18 months late. And
20 between those two extremes, the probability of it being
21 in-service is a linear line. So the net effect of that
22 assumption is that units, new units, are more likely to
23 be late than to be early.

24 The other factor is that the reliability
25 indices for units, following their in-service dates,

1 are slightly higher in their early years in service
2 than they are in later years, and so that captures a
3 lessor degree of availability of new units than mature
4 units. So those two effects are both in the F&D model.

5 Q. Let's take a specific example, and
6 perhaps you could help us out. Assume that we have an
7 880 megawatt unit that's being brought on, can you tell
8 us when that - and it's undergoing commissioning, it's
9 sitting there - can you tell us when you are going to
10 include that in your reserve margin calculation?

11 A. In the reserve margin calculation,
12 which is just the straight arithmetical addition of
13 capacity and comparison to load, it would be included
14 in the reserve margin capacity on the date that it is
15 forecast in-service date.

16 Q. On the...?

17 A. On the date that it is forecast to be
18 in service, on its planned in-service date.

19 The calculation we have just described, I
20 have just described, is how it is modelled in the
21 frequency and duration model. And we have, I believe,
22 the correct figure up on the board. The reserve margin
23 calculation is the second box from the top of this
24 figure, and the F&D calculation is the third box. So
25 the simple approach is taken in the reserve of margin

1 calculation, the probabilistic approach is taken in the
2 frequency and duration calculation.

3 Q. If you could turn back to page 10 of
4 Exhibit 137, which is the Figure 5.1 in the 1991
5 reliability review. I would like to refer you to the
6 vertical axis, please. Could you tell us what that
7 represents? Is that an annualized value or is it a
8 present value?

9 MR. TABOREK: A. There are two lines I
10 will describe; there are two different things. It's,
11 in essence, a per year cost. And in the case of the
12 horizontal line, the cost of adding a CTU, it's the
13 levelized carrying cost of the CTU, it's the present
14 value of the capital and OM&A over the life, amortized
15 to put it on an annual basis.

16 In the case of the unsupplied energy, it
17 is the amount of unsupplied energy saved in a year,
18 multiplied by the customer damage cost, with an
19 allowance for the cost of running a CTU.

20 Q. Talking about the cost of adding a
21 CTU, you were referring to a CTU block before. Is it
22 fair to say that that is a 672 megawatt block, in
23 effect, four times 168?

24 A. Yes.

25 Q. Looking at Figure 5.1, it looks as

1 though the annual cost of an additional 672 megawatt
2 blocks of CTUs is about \$29-million; is that fair?

3 A. Yes.

4 Q. Now, given a median firm load
5 forecast of 28.2 gigawatts in 2001, is it fair to say
6 that a 672 megawatt blocks of CTUs contributes about
7 2.4 per cent to the reserve margin?

8 I notice Mr. Snelson has a calculator.

9 MR. SNELSON: A. The numbers were?

10 Q. The CTU block is 672, and from the
11 plan report Figure 9.2, the median firm load forecast
12 for 2001 is 28.2 gigawatts.

13 MR. TABOREK: A. We chose that number of
14 megawatts and CTUs to give about a 2 per cent increment
15 in reserve margin to do this figure. It seemed to be a
16 convenient...

17 MR. SNELSON: A. 2.38 seems to be about
18 the right number.

19 Q. 2.38?

20 Now, I would like to do a brief exercise
21 in trying to interpret Figure 5.1. I would like to
22 know how the curve works, if I want to add a CTU block
23 of 672 megawatts. If I have this graph and I want to
24 add 672 megawatts, how do I read the graph?

25 MR. TABOREK: A. If you look at the

1 monthly curve on the left, in the year 2000, the top of
2 the curve is roughly at the \$35-million level.

3 Q. Yes.

4 A. And what that says is that you will
5 have added the block of CTUs to get you to the reserve
6 margin at that point on the curve, which is roughly 20,
7 and you will have saved 35-million in customer damage
8 costs.

9 That if the next block is added, that
10 will add about 2 per cent. So you would go down to 22
11 per cent, and you would save, by moving to that point,
12 you would have saved roughly 10-million, a smaller
13 amount.

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1 [12:36 p.m.] It's the gain in moving to the reserve
2 margin level indicated on the horizontal axis using
3 blocks of CTUs.

4 Q. So you start with Figure 5.1, you add
5 something, and then you move toward the reserve margin
6 that you end up with?

7 A. I didn't quite get to start with
8 Figure 5.1. If you just leave that off your phrase, I
9 believe you are expressing it correctly.

10 Q. So, is it fair to say, then, that
11 this curve represents the incremental value of the CTU
12 block given that the reserve margin after adding the
13 block is the value on the horizontal axis?

14 A. Correct.

15 Q. And the key word there was "after" as
16 opposed to "before"?

17 A. Yes.

18 Q. So, in looking at the monthly curve,
19 if we want to take our 672 block and apply it, the
20 incremental value of the last 672 megawatt block of CTU
21 capacity, which is required to meet the 24 per cent
22 target reserve margin, is the value of the curve at
23 reserve margin 24. Is that correct?

24 A. Yes.

25 Q. Which is zero?

1 A. Yes.

2 Q. Thank you.

3 A. This, incidentally, is another
4 reflection of the curve we were looking at that showed
5 the transmission and distribution and generation, all
6 on the same chart that showed the 1981 calculations.

7 And what you are seeing here is that, in
8 the reserve margins of 24 per cent shown here, there is
9 very little customer damage occurring, very little
10 unsupplied energy. But you will notice that, moving to
11 the left, you can get to a point quite quickly where
12 the costs begin to rise very sharply, and this is a
13 similar reflection of that.

14 MR. SNELSON: A. Another aspect of that.
15 And you will notice there is also a daily curve on this
16 figure. And these are two different assumptions as
17 regards the operation of hydraulic plant. And we
18 believe that, in reality, the operation is somewhere
19 between these two curves.

20 The monthly curve presumes that Mr.
21 Barrie and his system operators are clever enough to be
22 able to perfectly schedule water within a month so as
23 to use all the available water at the times when it is
24 of most value; that they know to save water this week
25 because there is a cold spell coming next week and they

1 will need it.

2 The daily curve assumes that each day the
3 available water is used, and used in that day to its
4 best advantage, but not in the month to its best
5 advantage. So the reality is probably somewhere
6 between the two curves.

7 Q. You have actually anticipated one of
8 my questions a little later, Mr. Snelson. Thank you.

9 In referring to Figure 5.1, if you only
10 had Figure 5.1 for the year 2000/2001, what would be
11 the target reserve margin?

12 MR. TABOREK: A. Well, I would go back
13 to the kind of logic I used earlier. I would look
14 at -- and am I permitted to use the monthly and the
15 daily, or just the monthly? Just the monthly?

16 Q. Let's start with the monthly and see
17 what we get.

18 A. I would look at the minimum total
19 customer cost occurring a shade above 20 per cent, and
20 then I would exercise the judgments in logic that I
21 described yesterday, and I would move to some point
22 more reliable than that. And I would be tempted to go
23 in the 23/24 per cent range, I think.

24 And because I can get there at little
25 additional extra cost and a great deal more of

1 reliability, and I am backing myself off the lip of
2 this cliff.

3 And I would do that, and the reason I
4 would do that, just to reaffirm the points I made
5 yesterday - and in a way this now begins to answer the
6 question about the other models - you have to give
7 people credit for doing these models, because they are
8 modelling very complex systems, very rare phenomena are
9 occurring, but the models don't capture everything and
10 the data is difficult to get.

11 And it's the nature of this analysis that
12 it will understate the true optimum. And that is a
13 second factor that would press me to move to the right.
14 For instance, Ken mentioned the fact that the actual
15 operation of our hydraulic system is not probably on
16 the monthly or the daily, but somewhere in between, so
17 that would cause me to move to the right.

18 So I have, in effect, indicated three
19 factors that would suggest one should not read just
20 where two lines cross and say, "That's it," because the
21 model said it did that. So I would go on the 23 to 24
22 per cent range with all of that.

23 Q. And the 23 to 24 per cent range is to
24 the right of the--

25 A. Right of the minimum.

1 Q. --intersection of both the monthly
2 and the daily curves with the cost --

3 A. And the intersection of the daily
4 curve is about 20, and the intersection of the monthly
5 is between 22 and 23. And so I have said --

6 Q. The other way round.

7 A. I'm sorry. The minimum for the
8 monthly is at 20, roughly; and for the daily curve,
9 it's about 22, 23. And so, in my judgment 23, 24,
10 using this only, and those bits of evidence.

11 Now, I have kind of put myself in a
12 rather sterile world. I would want to know an awful
13 lot more about the environment in which I was making
14 the decision, and the purpose of the decision. And I
15 would want to take all of those factors into account
16 before really making the choice. But with what you
17 have given me, that is what I would do.

18 Q. So you would take these curves, you
19 apply some judgment to it. One of the things you look
20 at is the fact that the reality is somewhere between
21 the daily and the monthly. Which do you attach --

22 A. The reality with respect to the
23 operation of the hydraulic system--

24 Q. Yes.

25 A. --in stressful conditions.

1 Q. Which would you attach more weight
2 to, the daily or the monthly?

3 A. The monthly.

4 Q. Why is that?

5 A. Judgment.

6 Q. Can you give us some of the factors
7 that would go into your judgment?

8 MR. SNELSON: A. I can give you some
9 factors.

10 Q. Thank you.

11 A. The reality is that there is a fair
12 degree of water storage on our system. Most of our
13 peaking hydraulic plants - and this is relevant mostly
14 for the peaking plants - most of our peaking hydraulic
15 plants do have water storage that allows the water to
16 be held back and used preferentially in days of high
17 demand and used less in periods of low demand. So we
18 do have that capability to schedule water.

hydraulic

19 And we do have a limited degree to be
20 able to predict the loads a few days ahead, maybe not
21 the full month ahead, so there is some capability to do
22 that. There are also operating practices where one is
23 getting close to running out of water in peaking
24 plants, where you start to take measures to conserve
25 water, just in case you end up running out.

1 So, this may involve increased use of
2 voltage reductions or increased use of public appeals,
3 or increased purchases over the interconnections, but
4 the operators would go to some considerable length when
5 they start to see a danger that they are going to run
6 short of water. And they will start to take actions to
7 try and avoid that circumstance.

8 Q. Mr. Taborek, you indicated that you
9 gave the monthly more weight. Can you give us an idea
10 of relatively how much more weight you would give it?

11 MR. TABOREK: A. I would interpolate
12 down the middle.

13 Q. So, it is, in effect, a 50 per cent
14 weighting for each of them?

15 A. No, I guess that's... You are asking
16 me for very coarse judgments, and I am loath to give
17 them, and I don't think I would like to quantify them.

18 Q. We can try and get away from the
19 quantitative, maybe just some sort of rough
20 qualitative. Is there substantially more weight on the
21 monthly than the daily? I got the impression from what
22 you said that they are in the same ballpark. Is it
23 fair to say that? The weighting practice for both are
24 similar?

25 A. I guess I don't think of it in that

1 sense. I usually tend to weight a number of things
2 together, and, yes, there is considerably more weight
3 on the monthly.

4 And so, for instance, in my direct, I
5 showed you the monthly curve as the typical
6 representation I would give to you. And that is to
7 simplify a very complex set of judgments that you have
8 to make.

9 Q. Yes. Looking at Figure 5.1, can we
10 convert the figures on the vertical axis to values in
11 dollars per kilowatt year by simply dividing by 672,000
12 kilowatts?

13 A. Yes.

14 MR. SNELSON: A. We can check that--

15 MR. TABOREK: A. We can check.

16 MR. SNELSON: A. --with people who are
17 more involved in these things, but we believe that is
18 the case. We would get back to you if it was
19 different.

20 Q. Well, then, I understand from your
21 earlier answer, then, that the average value of each
22 kilowatt in the last 672 megawatt block added would be
23 zero; is that fair?

24 A. To the scale shown on this figure for
25 the monthly curve, yes.

1 Q. And then, of necessity, every
2 kilowatt in the block, including the first one, would
3 be zero, as well?

4 A. I believe so.

5 Q. Thank you.

6 How much money could Hydro save in supply
7 costs, by reducing the reserve margin by 2.4 per cent;
8 in other words, by the size of a CTU block from, say,
9 24 per cent to 21.6 per cent?

10 A. That would be the cost of the 672
11 megawatts of CTUs.

12 Q. That would be the 29-million per
13 year?

14 A. That's as I interpret the figure,
15 yes.

16 MR. TABOREK: A. Yes.

17 Q. What would be the impact on
18 reliability of customer service, from reducing the
19 reserve margin by 2.4 per cent from 24 per cent to 21.6
20 per cent?

21 A. You would read that off Figure 5.1,
22 if I am understanding your question properly.

23 MR. SNELSON: A. According to this
24 model.

25 MR. TABOREK: A. According to this

1 calculation, yes.

2 MR. SNELSON: A. Recognizing that the
3 calculation is only a partial description of reality.

4 Q. If we are looking for the reliability
5 measure as -- perhaps I should rephrase the question
6 and make sure we are all talking in the same level.

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1 [12:52 p.m.] I was interested in the impact on
2 reliability. That would be, in effect, a system-minute
3 type of answer, if I understand the concept correctly.
4 And if, in fact, we were dealing with that, wouldn't we
5 find the answer in--

6 MR. TABOREK: A. Figure 5.3.

7 Q. --figure 5.3?

8 A. Of the same exhibit?

9 Q. Right.

10 A. Yes. That would give you for this
11 model and this conditions, the change in system
12 minutes, using the monthly hydraulic model.

13 Q. And that is at page 15 of Exhibit
14 137? And is it fair to say, in looking at figure 5.3,
15 the impact on reliability in reducing the reserve
16 margin from 24 per cent to 21.6 per cent would be an
17 increase of approximately two and a half system
18 minutes?

19 A. From 24 to 21.6? Oh, yes, okay. 24
20 is about one system minute, and 21.6 is about five, if
21 I run the scale, the left scale for the year 2000. For
22 the year 2005/2006?

23 Q. I was looking at 2000/2001 when I
24 took 21.6 and brought it up to the curve, just so that
25 we are doing the same thing. I then brought that over

1 to the vertical axis and got a figure of just above
2 four.

3 A. Okay.

4 Q. Then when I did the same thing with
5 24 per cent reserve margin, I brought that up and then
6 took that over to the vertical axis and got a value of
7 just under two.

8 A. Looks about right.

9 Q. So that would give us a difference of
10 the two of just over two, say, two to two and a half,
11 something like that?

12 A. Yes.

13 Q. So that would be the increase in
14 system minutes in reducing the reserve margin by 2.4
15 per cent. From 24 per cent to 21.6 per cent?

16 A. Yes, For the year 2000/2001. It
17 would be different for 2005/2006.

18 Q. Yes.

19 And the incremental value of the
20 increased customer outage, could you give us an idea of
21 what that would be?

22 MR. SNELSON: A. Are you talking about a
23 value, well, in system minutes? You have given us the
24 value.

25 Q. Dollars.

1 A. In dollars.

2 MR. TABOREK: A. Go back to table 5.1.

3 Q. The answer would be?

4 MR. SNELSON: A. The answer would be
5 very small. And the reason is the system minutes that
6 are being reported in figure 5.3 include public appeals
7 of reductions, which are presumed to have no cost
8 associated with them.

9 So, in the reduction in the reserve
10 margin that you are talking about, there would be a
11 significant -- there would be a measurable impact on
12 customers in terms of public appeals and voltage
13 reductions, but we do not impute a cost to that. So it
14 doesn't occur and doesn't come up in the economic
15 optimization of reserve.

16 Q. In effect, going back to figure 5.1,
17 in looking at the curve, as you say, the values can be
18 very small. In effect, it is going to be almost zero,
19 with the caveat that you put forward about voltage
20 reduction and appeals?

21 A. The amount of rotating load cuts,
22 which is what is costed, is very small. But the amount
23 of system stress incidents that would impact on
24 customers, there would be a measureable change.

25 Q. What would be the impact on total

1 customer costs of reducing the reserve margin in the
2 same way, 2.4 per cent from 24 per cent, to 21.6 per
3 cent, dealing with the 2000/2001 curve?

4 A. If you...

5 Q. Is that the same?

6 A. If you save \$29-million in avoiding
7 the addition of some combustion turbine units, and the
8 amount of costed rotating load cuts that changed is
9 very small, then total customer cost, in that sense,
10 would be down by very nearly \$29-million.

11 I come back to the view that we should
12 not only be looking at the 2000/2001 curve; that is, a
13 period in which there are no new generating units, and
14 the units that are on the system have been there for
15 some time and are presumed to have reached mature
16 forced outage rates. In a growing system, the 2005 and
17 2006 numbers may very well be more representative.

18 MR. TABOREK: A. And again to reinforce
19 the points made earlier, this type of analysis would
20 naturally tend to understate unsupplied energy.

21 Q. What would be the effect on NUG
22 payments of reducing the reserve margin by 2.4 per cent
23 from 24 to 21.6? Is it fair to say they would be
24 reduced?

25 MR. SNELSON: A. Yes, they would be

1 reduced, presuming that we may retain the same methods
2 of calculation that we are currently using.

3 Q. Do you have any idea of the
4 approximate impact on the NUG payments?

5 A. Per kilowatt of capacity, it would be
6 a reduction of 2 parts in 124 parts. So that is a 1 in
7 60 part of the capacity part of payment. The capacity
8 part of the payment is of the order of \$60 per kilowatt
9 per year.

10 I'm just giving you rough orders of
11 magnitude. And so it would be of the order of \$1 per
12 kilowatt per year. Now that is just rough estimating,
13 but I believe the orders of magnitude are right.

14 Q. What would be the effect on the
15 demand management plan of reducing the reserve margin
16 in the same way, by 2.4 per cent, from 24 per cent to
17 21.6 per cent?

18 A. There would be a small reduction in
19 the avoided cost calculation, and that would be
20 reflected also in the demand management avoided costs.
21 That may or may not be reflected into incentive
22 payments or any program design aspect, as to how the
23 demand management programs are implemented.

24 Q. And one more question before lunch.
25 What would be the impact on reliability of customer

1 service from spending an amount on transmission and
2 distribution upgrades, equal to the cost of increasing
3 the reserve margin by 2.4 per cent? In other words,
4 the \$30-million or the \$29-million.

5 A. I cannot give you an estimate on
6 that.

7 Q. Is it fair to say it would help?

8 A. Clearly, if you spend some money and
9 you spend it in the right places, it has to help. An
10 order of magnitude of that improvement, I don't think
11 there is anybody on this panel who could estimate that
12 for you.

13 It doesn't necessarily mean either that
14 it is a spend-it-on-one or spend-it-on-the-other. If
15 the money is justified on generation, then maybe it
16 should be spent on generation. Transmission is subject
17 to a whole set of other kind of conditions. And if we
18 decided to save money on generation reserve, it may
19 well be that the saving in money would show up as a
20 reduction in rates to our customers, rather than
21 increased spending on some other program.

22 Each program is more or less looked at in
23 its own right, but, of course, the corporation is also
24 doing calculations as to how much in total it can
25 afford. And so you can't say whether money saved in

1 one program would be available for spending in another
2 program.

3 Q. Mr. Taborek or Mr. Barrie, do you
4 have anything to add about the money being spent on
5 transmission and distribution; whether that would
6 assist?

7 MR. TABOREK: A. Well, first of all, one
8 would hope that expenditures would assist. And that
9 what you are looking for is if there are -- I presume
10 your question is aimed at asking whether there is a
11 greater benefit to the customer in spending in one area
12 than the other?

13 Q. We are looking at reliability.

14 A. From a point of view of reliability.
15 And that kind of analysis is something that not too
16 many -- well, people have not been able to do. You can
17 get some information on that, and you can make
18 judgments by looking at the differential gain in
19 unsupplied energy due to a dollar spent in generation
20 and a dollar spent in transmission, and to have -- and
21 those benefits should be matched against the customer
22 damages that are being incurred, or the savings in
23 customer damages. That is how you'd attempt to make
24 those judgments, to answer that question that you
25 posed.

1 MR. SNELSON: A. I would like to add
2 that I don't believe that we have any computational
3 tool that can estimate the amount of customer damage
4 due to transmission unreliability in a prospective,
5 forecasting way, for planning purposes.

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6 Now you did mention Procose. Procose, I
7 think, has some capabilities in that regard. But at
8 present, it is only practicable to look at it for a
9 very short period of time, for a closely defined set of
10 circumstances. And I don't think that it is practical
11 to do that calculation for a whole system, for a number
12 of years into the future, that will enable you to do
13 that sort of incremental calculation.

14 MR. TABOREK: A. I think, as during the
15 course of the morning, I hope we have given you a
16 measure that these reliability analyses of generation
17 can only take you so far. And when you now add the
18 complexity of the generation and the transmission
19 system together, people have a long way to go before
20 models can do that, if they ever get there.

21 MR. WATSON: Thank you, those are my
22 questions for the morning.

23 THE CHAIRMAN: We are going to adjourn
24 until 2:30. This afternoon we must stop at 4:30. Do
25 you think you will be finished this afternoon?

1 MR. WATSON: No.

2 THE CHAIRMAN: No. When do you think you
3 will be finished?

4 MR. WATSON: I imagine I will be most of
5 tomorrow.

6 THE CHAIRMAN: All right.

7 THE REGISTRAR: Hearing will adjourn
8 until 2:30.

9 ---Luncheon recess at 1:05 p.m.

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1 ---On resuming at 2:35 p.m.

2 THE REGISTRAR: Please come to order.
3 This hearing is again in session. Please be seated.

4 THE CHAIRMAN: Mr. Watson?

5 MR. WATSON: Mr. Chairman, you will
6 recall this morning that I was asking about the North
7 memorandum. And the panel undertook to try and find it
8 and they were somewhat apprehensive about whether they
9 could. I can tell you that they have found it and I
10 have it. What I suggest we do is make this the first
11 exhibit in the exhibit we are setting aside for Panel 2
12 undertakings. You will recall that we started that
13 process in Panel 1.

14 THE CHAIRMAN: Or it could just as easily
15 go in as the next exhibit, could it not?

16 MR. WATSON: Perhaps we could make the
17 next exhibit that exhibit for Panel 2 and we will put
18 everything in there as it comes forward.

19 THE CHAIRMAN: Is that all right?

20 MRS. FORMUSA: That's fine with me.

21 THE CHAIRMAN: What is the number?

22 THE REGISTRAR: The next number is 142.

23 THE CHAIRMAN: It will be 142.1.

24 ---EXHIBIT NO. ¹³⁴~~142.1~~: North Memorandum

25 THE CHAIRMAN: We haven't reserved it

1 yet, I don't think. Is that right, we didn't reserve a
2 number yet?

3 MR. WATSON: I don't believe we reserved
4 a number.

5 THE CHAIRMAN: We have one for Panel 1;
6 don't we?

7 THE REGISTRAR: Yes, No. 134.

8 THE CHAIRMAN: Okay.

9 MR. WATSON: I am not going to refer to
10 that this afternoon. I just received it and perhaps we
11 could have copies made and I will look at it tonight
12 and see if any questions arise from it.

13 THE CHAIRMAN: All right.

14 MR. WATSON: Thank you.

15 Q. Panel, if you could turn to page 16
16 of Exhibit 137, that is a page from the plan analysis,
17 and I like to refer you to the last sentence in the
18 first full paragraph at the top, just before 3.4
19 reliability criteria. It reads:

20 "For example, earlier studies on
21 generation system reliability (the System
22 Expansion Program Reassessment (1979))
23 found that a 5 per cent increase in
24 installed generation, results in a 60 per
25 cent decrease in unsupplied energy, at a

1 cost of increasing customer prices by
2 about one per cent."

3 Now, I would like you to turn over the
4 page, if you would, to page 17 of Exhibit 137, and you
5 will see under Total Generation Unreliability, the
6 second sentence talks about the 10-year average level
7 was 11.1 system minutes, significantly below the 78
8 system minute standard.

9 Now, you will recall this morning when we
10 were talking about SAIDI, there was table put forward,
11 and the SAIDI values were in the area of about 200,
12 250, in that area. What I would like to do is explore
13 the statement on page 16 in a little more depth.

14 First of all, is it fair to say that the
15 unsupplied energy from generation is a small fraction
16 of the total unsupplied energy? And I assume it is,
17 historically, from what we saw this morning in Figure
18 2.20.

19 MR. BARRIE: A. Historically, that is
20 true, yes.

21 Q. In fact, when we are looking at some
22 of the figures here, if we are looking at 11 system
23 minutes versus figures in the 200s or so, we are
24 talking about, say, a 5 per cent level, if you will?

25 A. Yes. But you are now using SAIDI

1 which is all unreliability, distribution, transmission.

2 Q. Yes.

3 A. Yes.

4 MR. SNELSON: A. Maybe I can just
5 clarify here and just to make sure we are on track. I
6 believe that SAIDI and CAIDI are for the Ontario Hydro
7 Rural distribution system.

8 MR. BARRIE: A. Yes.

9 MR. SNELSON: A. Which is mostly a rural
10 distribution system. It does not consider the
11 unreliability of the municipal electrical distribution
12 systems which covers most of the distribution of the
13 province.

14 Q. Well, if we are dealing with this
15 quote on page 16, the 5 per cent increase in installed
16 generation results in a 60 per cent decrease in
17 unsupplied energy, could you help me out a little bit
18 as to what you mean by that "unsupplied energy"? That
19 is not total unsupplied energy, is it?

20 A. It's unsupplied energy due to
21 generation unreliability.

22 Q. Right. And when we are looking at
23 the total unsupplied energy, is it fair to say that
24 that 60 per cent figure is going to decrease
25 substantially?

1 A. Undoubtedly, if you have a change and
2 you now express it as a percentage of a larger base, it
3 will be a smaller percentage.

4 Q. So if that sentence is changed to put
5 in the word "total" before "unsupplied energy," we are
6 going to have a completely different meaning to that
7 sentence; is that fair?

8 A. Yes. But the purpose of that
9 sentence was to describe generation unreliability, and
10 that's the subject that we are addressing here.

11 Q. But in fairness, when you are looking
12 at the balance of that sentence, you are talking about
13 the cost of increasing customer prices by one per cent.
14 That's the price that the customer sees, is it not, and
15 that deals with more than just generation
16 unreliability; isn't that fair?

17 A. That is the total price the customer
18 sees, and that statement was more or less based on
19 Figure 2-6 of the 1981 report which was attached to
20 Interrogatory 2.7.1 and we gave it its own Exhibit No.
21 this morning which I don't have recorded. 140, I
22 understand.

23 Q. But again, the costs that you are
24 talking about here in the sentence is the total cost
25 seen by the customer, and the effect on the customer is

1 going to be from more than just generation
2 unreliability. And when you are talking about total
3 unsupplied energy versus the generation unsupplied
4 energy, you are going to find that that 60 per cent
5 figure decreases substantially; isn't that fair?

6 A. First of all, you have used the
7 phrase "total cost." This quote is about customer
8 prices and the total cost is the sum of the customer
9 price of electricity and the cost to the customer of
10 unreliability. And if you look at Figure 2-6, of
11 Exhibit 140, the one per cent change is approximately
12 the slope of the underlying line of the cost of power.

13 The reduction in the cost of
14 unreliability to customers is such that in this figure
15 over the range of about 22 to about 27 per cent, then
16 there is no sensible change in the total customer cost.
17 The curve is more or less flat over that period.
18 Because the reduction in customer interruption costs is
19 approximately balancing the increase in the cost of
20 electricity; that is, the cost of power.

21 THE CHAIRMAN: Are you saying - just so I
22 understand this quotation on page 3.5 - that unsupplied
23 energy, the underlying words there should be
24 "unsupplied generation energy"?

25 MR. SNELSON: Yes.

1 THE CHAIRMAN: That is what it should
2 have said?

3 MR. SNELSON: Unsupplied energy due to
4 generation unavailability, generation problems.

5 THE CHAIRMAN: So that certainly doesn't
6 leap out at you from reading the plan analysis. The
7 quote is under a heading called "Reliability at What
8 Cost." There would be other costs involved then.

9 MR. SNELSON: Certainly. And we may have
10 been too close to it, that we are looking very closely
11 at the generation reliability and generation effects,
12 and we would write a sentence like that and perhaps not
13 put it into the proper context.

14 MR. WATSON: Q. Panel, if you could turn
15 to page 18 of Exhibit 137, which is Figure 5.2 of 1991
16 reliability study. Is the zero per cent probability
17 curve the same as the line that's identified as monthly
18 in Figure 5.1?

19 MR. TABOREK: A. Yes.

20 Q. I would like to you refer to the 100
21 per cent probability curve. Now, was that obtained
22 using the same input assumptions as the zero per cent
23 curve, except for the deletion of the two 880 megawatts
24 units?

25 A. Yes.

1 Q. Why did you chose to delete two 880
2 megawatts units, instead of one or, say, four?

3 A. Well, it was a judgment and perhaps
4 the judgment was based on the fact that we have had two
5 Pickering units out, we could have another two units
6 out. It's a credible failure.

7 Q. When you are running the F&D models,
8 how did you actually arrange for the two 880 megawatts
9 units to be deleted from the run?

10 A. Now, I am not sure but I would
11 presume that amount of capacity in this case would just
12 be zeroed out; it would not be there. It's a hundred
13 per cent certain, there is no uncertainty about it, so
14 just remove it from the run.

15 Q. Does it make any difference in your
16 run as to which units you delete?

17 A. Not unless there is some other
18 characteristics of those units that are important.

19 Q. Are there?

20 A. No, I couldn't imagine. Especially
21 if you are just deleting them.

22 Q. And that's what you do, you just
23 delete them?

24 A. Yes. I believe that. I have to
25 check because I think that's what would have been done,

1 but I will check.

2 Q. Why don't we just assume that's the
3 situation, then, if it's something different, you will
4 let us know.

5 A. Sure.

6 Q. Thank you. Looking at the 10 per
7 cent probability curve. Was that constructed simply
8 using a weighted average of the zero per cent curve and
9 the hundred per cent curve?

10 A. Again, I believe, yes.

11 Q. Was it a simple weighting--

12 A. Yes.

13 Q. --where you took the zero curve,
14 multiplied by .9, and the hundred per cent curve
15 multiplied by .1?

16 A. And I think... That looks to be the
17 case, yes, just interpolating.

18 Q. Looking at the zero per cent
19 probability curve, is it correct to interpret that as
20 representing the assumption of no common load failures?

21 A. Yes.

22 Q. Could you expand upon that, please?

23 A. The underlying logic of the F&D
24 program is that outages in one unit are not correlateed
25 or linked to outages in the other; that is, two units

1 won't fail or N units won't fail for the same cause,
2 i.e., for a common cause.

3 Having said that, there is some
4 possibility of common cause events occurring and we
5 acknowledge that we cannot model that, and so we give
6 consideration to that in various ways, and that's what
7 was done here.

8 Q. I could ask you about the hundred per
9 cent curve again. It represents any two large units
10 failing together. How do you represent the event of
11 more than it two large units being unavailable, owing
12 to a common cause?

13 A. We would then remove additional
14 units.

15 If I am correct in my a first assumption,
16 and, as I say, I will have to check that, then more
17 units coming out would just have the same effect.

18 Q. Would that affect the number of runs
19 you would do?

20 A. Excuse me just a moment, please; I
21 would like to consult, please.

22 Yes.

23 Q. So the question I asked, would you do
24 additional runs?

25 A. Yes, we would do additional runs for

1 that.

2 Q. Okay. Why did you choose a 10 per
3 cent probability curve? Why not 20 per cent or 30 per
4 cent?

5 A. Again, it was a number chosen. There
6 was no special -- any number of lines could be
7 interpolated freely by anybody, and it was just one we
8 chose.

9 Q. Could you give us some idea of the
10 factors that went into the judgment involved?

11 A. We noticed a variety of different
12 evidence about common cause outages. You will find, in
13 Exhibit 87, an indication that our forecasts of normal
14 forced outage rates is frequently wrong by virtue of
15 events, a number of which are common cause outages; I
16 think they would be classed as common cause outages.

17 And from time to time, we seek estimates
18 from people or forecasts, if you will, of what common
19 cause outages might be. And some of those estimates,
20 we have reported in some of our reliability indices
21 reports. And I think simply stated, we are not very
22 satisfied with those.

23
24 ...

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1 [2:45 p.m.] So, what we do when we do these
2 calculations is to note that this cause exists; one
3 should not grab one number of what the model will model
4 and use it; one should make allowance for these other
5 things.

6 Now having said that, to give a hard
7 judgment on precisely what that allowance should be, we
8 are not exactly too clear on, and we can't give you an
9 analytical representation. We are giving information
10 here that you can read across. It is in the range of
11 so many per cent, depending on what you choose.

12 If you look at the past errors we have
13 made in predicting forced outage rates, you might
14 choose a 50 per cent line. If you choose the 50 line,
15 I think you are assuming that you have not learned
16 anything from these past errors and that your
17 generation has not improved.

18 On the other hand, you can say, well, you
19 have only got by those problems, and there will new
20 problems in the future.

21 Having said that, we are left with the
22 problem. We have an effect. We can't model it. You
23 have to allow for it. And we have actually made an
24 allowance for it in a different way than in an
25 analysis.

1 We haven't talked yet about the fact that
2 one of the emergency measures we make an allowance for
3 is purchase over the interconnections. And we make an
4 allowance of 700 megawatts in a peak period; whereas,
5 the capability of the interconnections is much more
6 than that, and, again, depending on the circumstances
7 in which you find yourself.

8 Now the reason we limit ourselves to 700
9 megawatts is because we have observed that when we make
10 errors in forecasting our loads, other utilities around
11 us are making similar errors in the same direction, so
12 that if the reliability problem that hits us is a load
13 forecast type of problem, we and the other utilities
14 are in the same boat. And we won't have much in the
15 way of support for each other, so we limit the number
16 to 700.

17 Now to bring that to the issue we are
18 discussing, if we have a generation problem, a common
19 cause problem to our generation, it is very unlikely
20 that the utilities surrounding us would have that same
21 kind of problem. And therefore, one of the offsets, if
22 you will, one of the judgments we make, is that perhaps
23 the easiest way to cover the fact that the analysis
24 will not really address this issue satisfactorily is
25 not to try and do an analysis -- well, it isn't through

1 pursuing the analysis further, that would be
2 unsatisfactory, but to note that we may have a thousand
3 or two thousand megawatts additional available to us on
4 the interconnections for use in circumstances when we
5 have a common cause type of failure, but not when, as I
6 say, we have a load problem.

7 So that, I think, is why we didn't try to
8 push this analysis through to some final conclusion.
9 We didn't feel that would be productive. We felt this
10 other way of acknowledging and accommodating that was
11 more productive.

12 Q. Did you do any statistical analysis
13 of common load failure?

14 A. No.

15 Q. One last question on 5.2.

16 Does the 10 per cent probability curve
17 represent the severity and likelihood of any number of
18 units out for a common load failure, not just two?
19 ---Off the record discussion.

20 MR. SNELSON: A. I think the question
21 was whether this reflects the effect of more than two
22 units or only two units? Was that the question?

23 Q. That's fine, yes. Does it represent
24 two? And if it only represents -- or can it represent
25 more than two?

1 A. I believe it represents two 881
2 megawatt units. It would not represent three 881 or
3 four 881 megawatt units, but it might represent four
4 440 megawatt units. It might represent any combination
5 of units that was about that same amount of capacity.
6 Close enough.

7 DR. CONNELL: It could presumably
8 represent three, if you assigned a different
9 probability to it?

10 MR. SNELSON: If you assigned a different
11 probability, but I don't think we have done the
12 calculation of what the three units out of service
13 would mean, in terms of unsupplied energy. And so, I
14 don't think we have any basis to assign the probability
15 to it, in terms of three units.

16 MR. WATSON: Q. I understand that all
17 four units at a nuclear generating station share a
18 common vacuum building; is that correct?

19 MR. SNELSON: A. Yes.

20 MR. TABOREK: A. Yes.

21 Q. If that is so, could an instance
22 involving the vacuum building, for instance, the
23 venting of steam into the vacuum building, or the
24 failure of the vacuum building, cause all four units to
25 be shut down?

1 A. Yes.

2 Q. And how sudden would that be?

3 MR. SNELSON: A. I believe it would be
4 almost immediate. As soon as the vacuum building has
5 been used, because of a major incident in one
6 generating unit required it to be used, then all
7 remaining units connected by that vacuum building would
8 have to be shut down very quickly, because they would
9 no longer have one of their back-up systems
10 operational.

11 Q. So you would not have a lot of time
12 to arrange for emergency purchases to replace that lost
13 generation?

14 MR. BARRIE: A. No, you would not. This
15 would be an instance where that loss would be greater
16 than the normal contingency that we guard against. You
17 have sort of moved into the operating time frame here.

18 Yes, that would be beyond our normal
19 contingency.

20 Q. And how long would replacement power
21 be required?

22 MR. SNELSON: A. You would have to have
23 some form of replacement for whatever time it took to
24 clean up the vacuum building, and restore its
25 operational capability for the remaining good units in

1 the generating station, presuming that the problem that
2 was severe enough to cause the he vacuum building to be
3 used, and the generator that was faulted, is of
4 sufficient magnitude that that unit probably would not
5 be available for quite a long time.

6 So, if you are in a four-unit station
7 with one vacuum building, one unit is damaged,
8 sufficiently to cause the vacuum building to be used,
9 all four units will be shut down quickly. Three units
10 will be returned to service as soon as the vacuum
11 building can be put back into service. I don't have a
12 good estimate for that, though we have had that
13 estimate at various times. I don't have a number at my
14 fingertips.

15 Q. Could you get that for us, Mr.
16 Snelson?

17 A. Yes, we could.

18 Q. Thank you.

19 Are there any other common facilities
20 whose failure could result in the shut-down of two or
21 more units?

22 A. There have been incidents that have
23 caused it. The fish in the St. Clair River have a
24 habit of swimming together, and there has been the
25 occasion where a shoal of fish swam into the intakes of

1 the Lambton generating station and required all four
2 units to be shut down at the same time.

3 Q. So water intake is one example of a
4 common facility that could shut down more than two
5 units?

6 A. Yes.

7 Q. Any other examples besides water
8 intakes?

9 A. There must be others. Other causes
10 of common cause failure that are not due to the same
11 equipment being used, but can have implications for
12 more than one unit, is that occasionally we have
13 problems with frozen coal in very cold weather, and
14 that can affect several units, in fact, in several
15 different generating stations.

16 It tends not to put the unit out of
17 service, it tends to produce a derating of the unit.
18 You can only get as much power as you can get the coal
19 off the coal pile and grind it, and get it ready for
20 burning.

21 Q. Has any sort of risk assessment been
22 done to estimate the probability of these events?

23 A. We have had some looks at what would
24 happen if we lost a whole nuclear generating station
25 because of a vacuum building outage as one cause of

1 that.

2 Those calculations haven't been done for
3 some time. They tend to be estimated as very remote
4 probabilities, things which are too remote to be
5 covered off in normal reliability planning, though we
6 do like to give some consideration as to how the system
7 would behave under such circumstances.

8 Q. These events, I guess, were referred
9 to earlier as high risk/low probability events. Would
10 the probability of these sort of events be less than,
11 say, 1 in 2400?

12 A. I can't recall the numbers that were
13 put on them and I don't have a great deal of confidence
14 in the numbers that were estimated as probabilities,
15 because they are judgments of people, but they are
16 quite small probabilities.

17 If, by 1 in 2400, you are referring to
18 loss of load probability that many utilities plan to, I
19 would point out that I don't believe that that is a
20 realistic measure of a risk of failure. The 1 in 2400
21 is the risk of failing due to generation problems,
22 usually assuming no common cause outages, usually
23 assuming that the load forecast is exactly as
24 predicted.

25 Very few of these utilities take into

1 account load forecast uncertainty, and so, although
2 they quote a risk of 1 in 2400, an actual risk of
3 failing is probably an order of magnitude or more
4 higher than that.

5 Q. And the events that you are talking
6 about when you say that they are high risk/low
7 probability, are they in closer to the first order of
8 magnitude or the second order of magnitude that you
9 were just referring to?

10 LOLP A. The 1 in 2400 is quoted as a failure
11 once in ten years. I believe that the figures that
12 were put on to the use of a vacuum building in a
13 nuclear generating station were a lot lower than once
14 in ten years.

15 Q. Were lower than that?

16 A. Yes, a lot lower than 1 in 10 years.

17 Q. What would be the result on the
18 target reserve margin if a common cause failure of four
19 units was considered instead of two?

20 A. It would increase the reserve margin
21 that was required to produce an optimum and the degree
22 to which it was increased would depend upon what
23 probability you assigned to that happening, and,
24 therefore, what weight it got into any probabilistic
25 evaluation.

1 Q. What would happen to these curves?

2 A. They would be higher.

3 Q. They would shift to the right, in
4 other words?

5 A. Yes.

6 Q. And your answer is the degree to
7 which they would shift to the right would be a function
8 of the probability that you attach to the event?

9 A. If you assigned a hundred per cent
10 probability to the event, such as the dotted line, as
11 shown in Figure 5.2, then it would shift to the right.
12 But it isn't a reasonable basis for planning to assume
13 that there is a hundred per cent probability that some
14 very remote event will happen.

15 And so you then have to say, what weight
16 do I give that in my planning evaluation? And the
17 probability might be one means of assigning a weight to
18 that sorts of consideration.

19 It's also, perhaps, unreasonable to try
20 to assign specific numeric probabilities to very low
21 probability events depending on how good you think your
22 estimating methods are of estimating probabilities.

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1 [3:08 p.m.] You see, the way it is taken into account
2 in our planning, and we've said this several times
3 today, that we are aware that the models that we use do
4 not capture all of the uncertainties that we face.
5 And, therefore, we tend to deviate from the theoretical
6 lowest-cost point towards a slightly higher reserve
7 part of the region.

8 So if the reserve margin shows an optimum
9 of 21 per cent, then we know that for very small
10 increases in cost, according to the model, we can go to
11 23 or 24 per cent reserve, and we know that that gives
12 us more protection against these phenomena, such as
13 common cause outages, which we know are not included
14 at the point.

15 So this is one of the factors in our
16 judgment, to err towards the high reliability side of
17 the flat portion of the curve.

18 MR. TABOREK: A. If we were to add
19 common cause events to our model and seek to reproduce
20 these curves with it in, I think I would also try very
21 hard to get a higher emergency interconnection
22 assistance that we could probably obtain in those
23 circumstances into the model as well. And I would seek
24 to have both of those factors in the model at the same
25 time before judging changes.

1 MR. SNELSON: A. The point was made --
2 the question was asked as to how quickly could we
3 arrange emergency support, and the answer was given, it
4 will take some time.

5 I would also like to just bring into the
6 discussion the fact that we get emergency support
7 automatically and immediately, in the event of
8 contingencies, whether we arrange it or not. So if we
9 have a large loss of generation, the immediate effect
10 is that that power, or a large part of it, flows in
11 over the interconnections, as was described by Mr.
12 Barrie yesterday.

13 Now, there will be limits to how much we
14 can allow that to happen, and while we were bottled at
15 Bruce, we had an understanding with our interconnected
16 neighbors that we could operate the system in such a
17 fashion as to have two large Bruce units be replaced by
18 power automatically flowing in over the
19 interconnections, and that would not cause undue stress
20 on our neighbours' systems. So that was how we were
21 operating during that situation at Bruce.

22 And in the event of a vacuum building
23 operation, there would be some time to close, shut the
24 units down in an orderly fashion, and to attempt to buy
25 over the interconnections. It may or -- it depends on

1 our neighbours' situations, just how much support is
2 possible in that respect, but it would be at least two
3 units.

4 Q. I'd like to turn to the topic of
5 energy limited resources, and if you can refer to the
6 F&D manual, pages 12 to 14, and they are pages 19, 19A
7 and 19B of Exhibit 137.

8 THE CHAIRMAN: Go ahead.

9 MR. WATSON: Q. You will see these pages
10 referred to, the representation of hydraulic generators
11 under point 6. On page 13, they describe two models,
12 an economic model and a demand model.

13 Very briefly, as I understand it, the
14 ① economic model involves the construction of an hourly
15 hydraulic generation schedule, using a peak shaving
16 algorithm. Is that fair?

17 MR. TABOREK: A. Simply, yes. It is a
18 little more complicated than that, but yes.

19 ② Q. And the demand method, in effect,
20 repeatedly = iteratively adjusts the peaking hydraulic capacity to
21 avoid violating an energy constraint, without deriving
22 an hourly schedule?

23 A. The demand model utilizes the maximum
24 hydraulic capacity, and regardless of energy limits,
25 but in the process does make an attempt to check

1 whether energy limits are being violated. These two
2 models were features of the 1977 F&D model.

3 Q. Yes. Were either of these two models
4 used in deriving the curves in the '91 reliability
5 review? For instance, figure 5.1?

6 A. Both of these models have evolved,
7 and it is, I guess, the evolved versions of these
8 models that were used to produce the present numbers.

9 Q. Are these two models internal to the
10 F&D global model?

11 A. Internal, they are part of the F&D
12 program, yes.

13 Q. Are they part of the F&D model, or
14 are they separate entities? Are they subroutines in
15 F&D?

16 A. I'm not sure, unless someone else is
17 here -- I'm not sure.

18 I presume normal programing technique
19 would be to make these subroutines, so I would give you
20 that.

21 Q. Mr. Snelson?

22 MR. SNELSON: A. Well, as I understand
23 it, you can run the model in these two ways, and you
24 probably have slightly different data requirements, and
25 you probably have to switchs as to which variety of

1 model you are going to use. But how the model is
2 structured, I don't know, and...

3 Q. What model was used to construct the
4 hourly schedule?

5 A. It was an evolution of what is here
6 called the economic model. This economic model goes
7 from a hydraulic capability and develops a hydraulic
8 schedule from a monthly load duration curve, and it
9 applies it to daily curves. And as a result, it does
10 not properly levelize the daily load curves in its 1977
11 version. There has been work done since then that
12 allows it to levelize the daily load curves, and that
13 model is now termed our hourly.

14 The dynamic model -- or excuse me, the
15 demand model used -- sorry.

16 Q. I was going to ask you a few more
17 questions about the economic model, before you got into
18 the demand model, unless you want to deal with the
19 demand model now.

20 A. As you wish, at your convenience.

21 Q. Is Promod used? That is P-r-o-m-o-d.
22 Is that used for this purpose?

23 A. Not any longer. Promod, again we are
24 going back some way, and we have -- Promod was
25 originally a part of the process, but it is no longer a

1 part. It is all done now in F&D.

2 Q. Is the economic model like the
3 two-tier model in the consistent energy set, which has
4 daily and monthly calculations?

5 A. I don't know the answer to that.

6 MR. SNELSON: A. I don't know.

7 MR. TABOREK: A. I would doubt it
8 because the consistent energy set is an energy model.

9 MR. SNELSON: A. I don't think we know.

10 MR. TABOREK: A. Yes, I guess we don't
11 know.

12 Q. Could you tell us how the model does
13 the peak shaving to levelize the daily curves?

14 A. Basically, we have a hydraulic
15 capability, one for weekdays and one for the two
16 weekend days. We have daily load duration curves for
17 each of the 36 day types that are in F&D, and we apply
18 the hydraulic capability to flatten the load, the daily
19 load curves, and previously the economic model had
20 flattened the monthly load duration curves, with
21 uncertainty convolved in, I might add.

22 Q. So how does the model implement the
23 daily versus the monthly peak shave?

24 A. Well, what we have done is, if we are
25 talking about the economic model, the old economic

1 model was discarded, and the new model, which we call
2 the hourly description of hydraulic, was implemented,
3 and we know longer use the old model.

4 Q. So in your manual, on page 13, when
5 you're talking about economic models, you describe two
6 disadvantages?

7 A. Yes.

8 Q. The first one is the -- the first one
9 is that the model levelizes the thermal demand of the
10 load duration curve for the day type. Now I believe
11 there was some reference to this this morning, talking
12 about Mr. Barrie being able to predict accurately for a
13 month. And that is the essence of this problem, is it
14 not? What you are talking about here is you are -- we
15 have, in effect, an over...

16 A. I don't think this is the same
17 problem.

18 Q. Okay.

19 A. As I understand this problem, this is
20 a -- I have described a process where these models are
21 attempting to model complex things. And from time to
22 time, we have described limits that these models have
23 reached. And what we have here, and I don't
24 understand, really, why these people back in '77
25 modelled this just the way they did, but one of the

1 things, that it is a more correct modelling procedure
2 to do it the way it is now modelled.

3 What you would get if you attempted -- if
4 you modelled using the monthly hydraulic curve, and
5 daily curves were not really leveled, and now we level
6 the daily curves.

7 Obviously, I don't understand. I've
8 researched some of the work back then, which is why we
9 were able to find that report so quickly, but I can't
10 find all the evidence of what went on back then.

11 Q. So is what you are saying, in effect,
12 that the current version of this model, in effect,
13 takes care of that problem?

14 A. It is a better representation of the
15 hourly or economic model, yes.

16 Q. Doesn't avoid it; it is just a better
17 representation of it.

18 A. Well, it is a better representation.
19 Again, we still remain -- we right now are struggling,
20 as we discussed this morning, for a good representation
21 of the behaviour of our hydraulic system under
22 uncertainty. It is one of the pivotal difficulties we
23 have in modelling, and it is an area where we are
24 different than most U.S. utilities, because of the fact
25 of our hydraulic capacity.

1 Q. So you are using some evolution of
2 the economic model right now. Are you using...

3 A. For the hourly curves.

4 Q. On the hourly curves. Are you using
5 the demand model, or some evolution of that today?

6 A. Yes, I think you could call it an
7 evolution. The demand model basically assumed that the
8 full capacity of the hydraulic system was available for
9 any period of time. And the modellers at the time
10 recognized that energy limits would limit the output.
11 And they attempted to check whether they were impacting
12 on energy limits by -- well, they separated out the run
13 of river, and then they took the peak, and they found
14 out how much peak they would expect -- peak -- how much
15 energy the peaking hydraulics would expect to use, and
16 then they compared that against the amount of energy
17 that was available to these units on a monthly basis.

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...

1 [3:25 p.m.] Now what they did is they checked against
2 an expected value. An expected value is sort of a
3 weighted average of a range of outcomes. And as a
4 consequence, when you have a range of outcomes, while
5 you may pass the test of the mean, some of your less
6 probable or outlying events may be giving you exactly
7 the problem you have been seeking to check for. It
8 wasn't a sufficiently discriminating check.

9 Now having said that, when we have talked
10 about incorporating hydraulic energy limits in our
11 model, or improved hydraulic energy limits, what that
12 boiled down to, in essence, was instead of checking
13 against the expected outcome, the mean, to check
14 against the distribution or levels of outcomes.

15 And so what you would find then is that
16 more often you would find that you would be running
17 into energy limits. And what the model does now when
18 it does its check is it checks at different levels of
19 load forecast, it identifies the energy -- the
20 instances in which there is unsupplied energy and
21 tallies them as part of the unsupplied energy so you
22 get more unsupplied energy than if you had run the
23 demand model.

24 And then, in other cases, of course,
25 since we are looking at the mean, you will find that

1 you pass with flying colors so you back off your
2 thermal system more.

3 But that, in essence, is what the
4 incorporation of hydraulic energy limits into the
5 models has accomplished, or how it was done. So it's
6 an evolution, I think, of the demand model.

7 Q. The two models that you have, the
8 economic model and the demand model, I get the
9 impression, looking at these, that they were somewhat
10 discrete, at least originally they were separate,
11 separate entities. I get the impression now, in
12 listening to you, that there is more of a convergence
13 now in these two models; is that fair?

14 A. I have trouble relating to what you
15 described. The F&D is a suite of programs and sub
16 programs. And I think there is a convergence, in that
17 both types of models have been improved. I don't know
18 that you would go further than saying that.

19 Q. Are these models, the economic model
20 and demand model, mutually exclusive?

21 A. Mutually exclusive, with respect to
22 what? That you run one?

23 Q. That you run one of them and not the
24 other?

25 A. Not the other? I don't know. I

1 believe so, but I will check it, and get back to you if
2 it's not case.

3 Q. Thank you. In the manual, there is
4 an estimate of 285,000 megawatthours per month for
5 peaking hydraulic energy?

6 A. Yes.

7 Q. Is that estimate still in the model
8 and is it still valid?

9 A. Well, that is the number I was
10 referring to, the expected value that was used to check
11 whether energy limits are being impinged on, and
12 instead of that number being in the model, which is the
13 expected value of the distribution, what we now do is
14 check against the distribution of errors that could
15 occur.

16 Q. In the 1991 reliability review,
17 Exhibit 87, you do account for hydraulic energy limits?

18 A. Yes.

19 Q. When did you first account for
20 hydraulic energy limits?

21 A. It's something that -- well, as you
22 can see, we have been working on it, I think almost
23 fair to say, perpetually and continuously. That some
24 of the work that I am aware of was done perhaps '85-86.
25 I don't know that we have even -- we are just now, in

1 effect, getting a prototype ready. So that when we
2 said we had a model prepared to use for production
3 purposes, I think is now. And even that model is not
4 yet fully a production model. It's quite complex to
5 run.

6 Q. Well, in Exhibit 87, the energy
7 constraints are taken into account in your analysis--

8 A. Yes.

9 Q. --in coming to your bottom line with
10 respect to system minutes and reserve margin?

11 A. Yes.

12 Q. When you were calculating your
13 reserve margin system minutes, prior to 1991, did you
14 use energy constraints?

15 A. Only the expected number.

16 MR. SNELSON: A. I think our central
17 calculation would have been used the demand model with
18 the check against the expected value which Mr. Taborek
19 has mentioned, and, in most cases, that did not prove
20 to be a constraint. So, in most cases, the system
21 would not require, on that basis, more energy from the
22 hydraulic units, assuming they are the last units
23 loaded and they are capable of being provided.

24 Just as an illustration of the point that
25 Mr. Taborek was making, about the difficulty of that

1 model, when the F&D program was originally conceived,
2 it did not have load forecast uncertainty rolled into
3 it, as part of the uncertainty in the load.

4 And these hydraulic models, that are
5 described in the original manual which we have, are
6 reasonably appropriate for the situation without load
7 forecast uncertainty, but ceased to be effective when
8 you do have load forecast uncertainty.

9 And put very simply, these models assume
10 that you can store water, in a year when you have
11 underforecast your load and you have lots of
12 generation, and use that water in a year when you
13 have -- sorry, the other way around.

14 They assume that you can store water in a
15 year when you have overforecast your load, and you have
16 much more generation than you need, and use that water
17 in a year when you have underforecast your load and you
18 have a generation shortage. And while we do have some
19 ability to store water on a monthly basis, and a very
20 small amount on a seasonal basis, we really have almost
21 no capability to store water from one year to another.

22 So the demand model, as it was originally
23 drawn up, did not properly account for hydraulic
24 limits, and that's why you have seen language saying
25 that we needed to have further work on hydraulic energy

1 limits. And that's why we did further work on
2 hydraulic energy limits, and why we have an improved
3 model in Exhibit 87.

4 Q. And if I understand Exhibit 87
5 correctly, there were ^{five} ~~three~~ factors that you elaborated
6 upon, which allowed you to reduce your system minutes
7 from 25 to 10. And one of those --

8 MR. TABOREK: A. Perhaps I can pick that
9 up again, because those three factors are not the three
10 factors that allowed that to happen. There was one
11 factor that did it, which is not one of those three.

12 Q. And that one factor is?

13 A. In my direct evidence yesterday, I
14 identified the fact that it, really, when we finally
15 broke through and figured it out, it was the fact that
16 we had made different allowances for public appeals in
17 1981 and now.

18 In 1981, we had assumed 10 per cent would
19 be available, and now we are assuming 2 per cent. And
20 that is the factor that makes the system minute
21 difference.

22 Q. Okay. Just so I understand, it's
23 fair to say, when I look at page 9 of Exhibit 87, you
24 are talking about the reduction of the system minutes
25 from 25 to 10. And you are say there are three factors

1 . primarily causing this change.

2 A. Yes.

3 Q. And the first one that you mention is
4 hydraulic energy limits.

5 A. Those were, to put it bluntly, those
6 three statements are wrong.

7 Q. Okay.

8 A. And I wrote them, so I know.

9 We had a situation, we thought we knew an
10 answer, we had to get the report out, and so we had to
11 give the answer we thought was right.

12 And having issued the report and having
13 carried on work, we found that those weren't -- true,
14 those are all significant differences, but they are not
15 differences which cause 25 to become 10. What causes
16 that is the difference in the assumption on public
17 appeals.

18 THE CHAIRMAN: What page is this in
19 Exhibit 87?

20 MR. TABOREK: Page 9 of Exhibit 87.

21 MR. WATSON: That's on page 9 of Exhibit
22 87, Mr. Chairman.

23 THE CHAIRMAN: Right at the end of the
24 chapter?

25 MR. WATSON: Yes, the overall summary,

1 the last page. They are talking about the reduction of
2 the system minutes from 25 to 10, and then there is a
3 line there, there are three factors primarily causing
4 this change.

5 THE CHAIRMAN: Yes.

6 MR. WATSON: Q. Mr. Taborek, as I
7 understand it, you are saying that those three factors
8 are not the factors that cause it and there is one
9 factor that causes it and that one factor is the
10 reduction in the 10 per cent for voltage reduction and
11 appeals?

12 MR. TABOREK: A. Public appeals.

13 Q. To 2 per cent?

14 A. Yes.

15 MR. SNELSON: A. Just public appeals.

16 THE CHAIRMAN: Just public appeals.

17 MR. TABOREK: Just public appeals, not
18 voltage reduction.

19 THE CHAIRMAN: Would this be a good time
20 to take a break?

21 MR. WATSON: Yes, Mr. Chairman.

22 THE REGISTRAR: The hearing will recess
23 for 15 minutes.

24 ---Recess at 3:35 p.m.

25

...

1 ---On resuming at 3:53 p.m.

2 THE REGISTRAR: Please come to order.

3 This hearing is again in session. Please be seated.

4 MRS. FORMUSA: Once again I apologize.

5 THE CHAIRMAN: Mr. Watson.

6 MR. WATSON: Q. If we could take up
7 where we left off, Mr. Taborek, again talking about the
8 reduction in the system minutes from 25 to 10, and you
9 are going to have to bear with me. It's going to take
10 me a little bit of time I think to understand this.

11 What you are saying is the three factors
12 here are no longer the factors that contribute to that
13 decrease; is that correct?

14 MR. TABOREK: A. That's correct.

15 Q. Do they have any value at all or are
16 they of zero value?

17 A. Well, they have an effect on the
18 system in that just as we say that when you recognize
19 hydraulic energy limits on the system, you will
20 experience more in the way of unsupplied energy and
21 that that will cause you to shift towards a more
22 reliable system; and similarly the same sorts of
23 phrases with -- same sorts of comments with respect to
24 CTUs and lead times.

25 Now, we thought that that accounted - and

1 it was a speculation - for the effect on system
2 minutes, but while the system minutes had gone down,
3 reflecting a move to a more reliable system, the
4 reserve margin had not, the reserve margin had stayed
5 the same, 22 per cent roughly.

6 And it was taking those two factors
7 together and having a little more time to work at this
8 that we finally realized how to account for that, and
9 it is as I described in my direct evidence yesterday
10 that the reason that we are now at 10 system minutes
11 rather than 25, is that the way you do the calculation
12 is you compute load cuts which are costed and then you
13 compute -- and you add to that the unsupplied energy
14 that is a result of public appeals and now voltage
15 reductions. And in both instances, the minimum total
16 customer cost with rotating load cuts came at just a
17 few system minutes.

18 And then what you effectively do is you
19 add on your public appeals, system minutes and public
20 appeals, and the system minutes and voltage reductions.
21 And when you add on the system minutes from a 10 per
22 cent return from public appeals compared to a 2 per
23 cent return from public appeals, that is what takes you
24 from -- and that you only go to 10 system minutes
25 rather than 25.

1 And then the other side of this: Why
2 didn't the reserve margin change at the same time? The
3 reason the reserve margin apparently hasn't changed at
4 the same time is that the forced outage rates that were
5 being used in 1981 for the thermal units were quite a
6 bit higher than the forced outage rates that are being
7 used now.

8 MR. SNELSON: A. I think it is fair to
9 say that all these factors have an effect, and the
10 change that has taken place is that rather than
11 ascribing it to a combination of three factors, we were
12 blind, if you like, and we failed to see a fairly
13 obvious factor that explained a very large part of the
14 change. These factors are still significant
15 differences between the reliability calculations before
16 and after; they just are not the main reason of the
17 change in the system minutes.

18 Q. Thank you. The three factors that
19 are referred to on page 9, they all state a proposition
20 and then they state a conclusion. For instance, the
21 first one says "Hydraulic energy limits on the system
22 are now recognized, leading to higher reliability."
23 Are all those three statements still correct?

24 MR. TABOREK: A. Yes. But they are not
25 correct in describing 10 system minutes.

1 Q. I understand that.

2 But by themselves, each statement is
3 correct?

4 A. Each statement is correct, yes.

5 Q. But together they don't have the
6 weight that you were ascribing to them--

7 A. That's correct.

8 Q. --to reduce the system minutes, and
9 that is being done by the reduction of appeals?

10 A. Yes.

11 MS. PATTERSON: On the third point, is
12 that correct, the third one where it says "Lower
13 reliability...

14 MR. TABOREK: Yes.

15 MR. SNELSON: It's a convoluted argument.
16 The point is that with a long lead time you have to
17 plan on a very large generation reserve to cover off a
18 lot of uncertainty. And with the shorter lead time,
19 you can plan for a lower reserve margin. You may also
20 optimize at a slightly lower system minutes of
21 unsupplied energy. That's not quite so clear. But
22 clearly this will lead you to making use of the shorter
23 lead time to permit you to plan to a lower level of
24 reserve margin.

25 MS. PATTERSON: Thank you.

1 MR. WATSON: Q. So in reducing the
2 appeals if you will from 10 per cent to 2 per cent, how
3 does that reduction affect the change in system
4 minutes?

5 MR. TABOREK: A. As I have explained,
6 the economic calculation determines the system minutes
7 that are costed, i.e., that are associated with load
8 cuts, and that turns out to be just a few system
9 minutes.

10 And then to find out what the system
11 minutes for our target are when we are also taking into
12 account public appeals and voltage reductions, which we
13 count but we don't cost, you then add to the system
14 minutes that you got for the voltage reductions, system
15 minutes for public appeals and voltage reductions.
16 Previously they had added system minutes equivalent to
17 10 per cent public appeals which was close to 25 system
18 minutes; a small number plus this gave you 25.

19 Now to this small number, we add the
20 system minutes equivalent to 2 per cent public appeals
21 and that gives us 10 in effect, with allowance for some
22 small voltage reduction numbers.

23 Q. When you reduce the impact of the
24 appeals, doesn't that increase the load cuts?

25 MR. SNELSON: A. If you kept the system

1 the same, yes, it would. If you had exactly the same
2 system and you said that now I can only rely upon 2 per
3 cent load reduction due to public appeals instead of 10
4 per cent load reduction to public appeals, then clearly
5 there would be more load cuts if that was all that
6 happened.

7 But if you have said because I am
8 allowing only 2 per cent for customer appeals, then I
9 need more reserve margin and I have changed the system,
10 then you find that the increased reserve margin to
11 accommodate the lower amount of public appeals has an
12 offsetting effect on the unsupplied energy; and so you
13 will come back for an economic optimum to about the
14 same amount of unsupplied energy from rotating load
15 cuts, and you will end up adding to it a different
16 amount of unsupplied energy, as Mr. Taborek has said,
17 counted but not costed for public appeals.

18 That is the combination of circumstances
19 that leads to a lower level of system minutes being the
20 apparent optimum of reliability.

21 Q. We got into this because I was asking
22 some questions about energy constraints and --

23 THE CHAIRMAN: Before we leave it.
24 Exhibit 87 is an exhibit in this evidence in this case.
25 It was one of the exhibits that the panel relied on

1 when they opened up their hearing.

2 I have no idea - at the moment I wouldn't
3 even express an idea if I had one - as to what the
4 significance is, but if there is something like this
5 that is not only just mildly but is dead wrong, as I
6 think I heard, I think it would be better in the future
7 if that were demonstrated and doesn't come out in the
8 course of cross-examination.

9 I won't say any more about that than
10 that, but that would be a better way of doing it.

11 MRS. FORMUSA: I think in terms of
12 addressing it in evidence-in-chief, it was addressed.
13 The statement, I agree with you, that perhaps we should
14 have gone to that page and corrected the page. So I
15 appreciate that.

16 THE CHAIRMAN: All right.

17 MR. WATSON: And Mr. Chairman, we may
18 have some more questions on this tomorrow.

19 We will certainly look at this tonight.
20 But that will deal with this particular area for now,
21 except...

22 Q. As I said, we got into this because I
23 was talking about energy constraints and when they were
24 first accounted for. And I understand that while they
25 were accounted for in 1991 in this Exhibit 87, what I

1 was interested in as well as whether energy
2 constraints were accounted for in the DSP.

3 MR. TABOREK: A. They were accounted for
4 in the sense of they were accounted for in the demand
5 model which is imperfectly, and I guess the simplest
6 way is to say no, they weren't accounted for because it
7 was not an adequate accounting.

8 Q. What is the effect on the required
9 reserve margin of accounting for --

10 A. If I may, I would just like to come
11 back on one point.

12 Q. Sure.

13 A. Within the model, I would come back
14 and say there are again deficiencies in models, and
15 models alone do not solely set the numbers people use
16 in their analyses.

17 We do use our judgments, we do check
18 ourselves against others, so to recognize the limits in
19 models. We were quite comfortable that the reserve
20 margins we used in the DSP were adequate for our system
21 and to that extent, they covered energy limits.

22 And so coming back that reliability for
23 generation planning is not just running models and
24 using the output of models. It is one of the tools we
25 use, and it's an imperfect tool but a valuable one.

1 Q. So what you are saying is in the DSP
2 there is a judgment, there was a judgment used in the
3 same way that there is judgment used today in the same
4 way there was judgment used in 1981?

5 A. Yes.

6 Q. And while the model has evolved and
7 is now taking account of energy limits and it didn't at
8 the time --

9 A. We are still using judgment and the
10 model still does not account for many other things. We
11 still use judgments and the reserve margins that we are
12 putting forward now and previously are appropriate for
13 the use in the DSP, and they cover all the appropriate
14 factors.

15 Q. And today's model with energy
16 limitations is attempting to take away some of the
17 judgment that you would have used earlier?

18 A. Yes.

19 Q. Could we look at the effect on the
20 required reserve margin of (1), accounting for
21 hydraulic energy limitations relative to (2), ignoring
22 these limitations. Could you give me a rough idea of
23 what happens?

24 A. Could you be a little more specific.
25 What effect are you looking for?

1 Q. Okay. If you look at Figure 5.1, for
2 instance, where would Figure 5.1 be without energy
3 limitations? Would the curve shift to the left for
4 instance?

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1 [4:09 p.m.] A. They would shift to the left.

2 Q. And that means it would shift toward
3 a lower reserve margin?

4 A. A lower reserve margin, yes

5 Q. Can you give us a rough idea of how
6 much it would shift, if energy limits weren't involved?

7 A. I think about three per cent--

8 Q. Three per cent.

9 A. --in some cases, and again, I will
10 have to check that.

11 Q. Did you consider the uncertainty in
12 hydro^{av.}logical conditions, when you were working on these
13 models?

14 A. No, we work with median hydraulic.
15 And again, the fact that the amount of water available
16 to us will change from low water years to high water
17 years, it is not a feature of the F&D model.

18 Q. So you used a median hydrological
19 scenario, as opposed to a wet or a dry scenario?

20 A. Yes.

21 Q. So that is the basis for the '91
22 reliability review, and that is also the basis for the
23 D/SP?

24 A. Yes.

25 MR. SNELSON: A. I think we have already

1 said that the reliability studies for the D/SP
2 effectively did not include hydraulic limits, and so it
3 is immaterial whether the hydraulic limits that were
4 not included were median or dependable.

5 Q. Can you give us an idea of why, in
6 the '91 review, you used a median hydrological
7 scenario, as opposed to a dry scenario? The dry would
8 be more conservative, would it not?

9 MR. TABOREK: A. Yes, it would be more
10 conservative. We have traditionally used the median,
11 and, I guess, there is a much smaller capacity
12 difference, if I recall, with hydrological conditions,
13 than there is with energy difference. And until we had
14 a better representation of energy limits, I think that
15 there was not a strong incentive to go on and
16 incorporate other features in the model. I think that
17 would be the main reason.

18 MR. SNELSON: A. I think the simple
19 reason is that if we used the dependable water
20 condition, which in our definition is a "once in 50
21 year" dry water year, then we would significantly bias
22 these results and our conclusions about the expected
23 unsupplied energy, and the expected cost of unsupplied
24 energy, and how to balance that per customer costs.

25 All those conclusions would be

1 significantly biased. If you have to use only one
2 estimate, then the median is the best estimate we have.

3 Clearly, a better model would be to
4 include a range of estimates and so on, but that is a
5 significant increase in the calculation, and it has
6 taken us a long time to get to this stage of hydraulic
7 modelling. We haven't gotten that far yet. And I
8 wouldn't like to predict when we would be able to do
9 that, or whether we plan to at all.

10 But clearly, if you only have one number,
11 and you don't want to produce a biased estimate, the
12 median is a better estimate than some point way out on
13 the tail of the distribution.

14 Q. Could I define another concept for
15 you? Hydraulic discount: This is the reduction in
16 hydraulic generating capacity, reflecting the fact that
17 some portion of the capacity is not usable, because of
18 insufficient energy behind it.

19 Would you care for me to repeat that, or
20 is that pretty straightforward?

21 A. No, I have got it.

22 Q. Can you tell me what is the discount
23 in the hydro capacity?

24 A. I don't believe that, in this
25 calculation, we produce anything which can be said to

1 be the hydraulic discount, with your definition.

2 Q. Do you have a similar term that you
3 would use?

4 A. No, we do not, because this is
5 handled in the modelling program, and I don't believe
6 that we have a separate number.

7 We do have, in our energy production
8 model, which is the load management strategy testing
9 model - LMSTM, for short - which is used throughout the
10 energy production model, there is a number similar to
11 that in there. And it was given in answer to
12 interrogatory 10.4.1, if my memory serves me correctly,
13 which is a huge volume of data, of all the data that
14 goes into the LMSTM model.

15 Q. That was that big black binder.

16 A. Yes, and the reliability model
17 attempts to model the operation of hydraulic in this
18 sort of peaking mode, and what it can do and what it
19 can't do for peaking purposes.

20 The energy production model, which has to
21 consider the whole period of the year, for
22 simplification, does have a similar concept to your
23 hydraulic discount in it. So that the hydraulic is not
24 overused and that the hydraulic operation comes close
25 to actual system operation.

1 Q. I understand that the LMSTM model is
2 different temporally from what we have been dealing
3 with. We have been dealing with monthly tabulations,
4 whereas, I believe, LMSTM works on a seasonal basis,
5 does it not?

6 A. That is correct. It works on four
7 seasons.

8 Q. Wouldn't that have an effect on the
9 discount?

10 A. What did you mean by that?

11 Q. When you have a greater time period,
12 doesn't that imply that you can have greater shifting
13 of the energy behind the capacity, and, therefore, the
14 results could be different?

15 A. I'm not implying that the hydraulic
16 discount that is in the LMSTM model is applicable to
17 the reliability analysis. It is applicable to the
18 LMSTM model and only to the LMSTM model, and that was
19 the purpose for which it was developed. It is just a
20 similar concept which is in some of the materials.

21 Q. In looking at figure 5.1, which is
22 back on page 10 of Exhibit 137, in evaluating the
23 reserve margin on the horizontal axis, what value is
24 used for hydraulic capacity?

25 A. The dependable peak capacity is what

1 I would expect to be used.

2 Q. Dependable peak capacity?

3 A. Capacity. That is, Mr. Taborek has
4 said, that is very little different to the median peak
5 capacity. The difference between dependable and median
6 is quite large in energy and quite small in capacity.

7 Typically in our system, the difference
8 in capacity is about 200 megawatts between dependable
9 and median on the whole system. And that is out of
10 about 6000 megawatts of hydraulic.

11 In terms of energy, the difference
12 between dependable and median is of the order of six
13 terawatthours, out of a total of about 36 terawatt
14 hours.

15 So it is much more significant than
16 energy of capacity. For the reserve margin, I believe
17 the figure used is dependable peak capacity. But it
18 wouldn't change much if it were median capacity.

19 Q. Was the same capacity used in
20 evaluating the reserve margin for the DSP?

21 A. I would expect so. If we were to be
22 incorrect in this respect, we will get back to you.

23 Q. Thank you.

24 Do you count for energy constraints on
25 any other resources other than hydraulic? One of the

1 things I was thinking of is something we discussed
2 earlier this morning, the fact that there were some
3 supply constraints on Lennox in 1989. That is one
4 example.

5 MR. TABOREK: A. Fuel constraints are an
6 example of energy limits, and acid gas control
7 constraints are examples of energy limits. But in
8 those instances, they are not brought into the model,
9 because the solution is not to build new generation to
10 accommodate them but to improve either your fuel supply
11 system or to improve your emission control system,
12 rather than just build new generation. So they are not
13 in the reliability model.

14 MR. SNELSON: A. But there are some
15 other energy or, effectively, energy constraints that
16 are in the reliability model.

17 The use of interruptible loads is limited
18 to certain terms and conditions, because they are only
19 permitted to be interrupted for so many hours, and so
20 that is considered in the model. And, of course, load
21 shifting, which is a shifting of load from peak periods
22 to off-peak periods, is inherently a zero energy
23 contributor. So that is inherently an energy limit
24 that is modelled in the system.

25 Q. If you could turn to page 20 of

1 Exhibit 137, which is page 75 of the '91 reliability
2 review, the third sentence on page 75 reads:

3 "In calculating the effect of energy
4 limits on reliability, allowance was made
5 for 2000 megawatts of off-peak energy."

6 How did you implement this in your model?

7 MR. TABOREK: A. You mean how was it in
8 the code, or what was the logic that we used to do
9 this?

10 Q. The input data.

11 A. I believe it would be a generator,
12 with characteristics to run during the appropriate
13 times, but I don't know exactly. I will have to check,
14 and I will get back to you if it is different. It
15 would be a generator running at 700 megawatts at peak
16 and 2000 off-peak; a perfect generator, too, I think.

17 Q. Does the 2000 megawatts off-peak have
18 any effect on reliability on-peak?

19 A. To the extent that it allows you to
20 replenish your hydraulic reservoirs, in effect, and
21 apply that on-peak, yes.

22 Q. Does your modelling account for that?

23 A. Yes.

24 Q. In looking at this, was the energy
25 constraint of the hydraulic units modified?

1 MR. SNELSON: A. Modified from what?

2 Q. Dealing with that 2000 megawatts,
3 what was the effect on the target reserve margin?

4 MR. TABOREK: A. A percent or two, I
5 believe.

6 Q. Increase or decrease?

7 A. It would allow a decrease.

8 Q. And on the next page, page 21,
9 talking about interruptible loads.

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1 [4:26 p.m.] It appears as though the interruptible
2 service contracts have limits on how many hours they
3 may be invoked. Are these limits modelled in the F&D
4 model?

5 A. Yes.

6 Q. How are they modelled?

7 A. These are, in effect, another form of
8 energy limit that Mr. Snelson referred to.

9 Q. And how are they accounted for in the
10 model?

11 A. I'm sorry, I don't know the answer to
12 that.

13 *Intensity 2.6.32* Q. Do you know what effect these limits
14 would have on the target reserve margin?

15 A. No.

16 Q. Can you tell us whether there
17 would be a shift one way or the other, to the left or
18 right?

19 A. Well, the presence of limits means
20 that there is less assistance available. It would mean
21 that one would require a higher reserve margin because
22 of the limits.

23 MR. WATSON: I am about to turn to
24 another sub-category within reserve margin. You
25 indicated that you wanted to break at 4:30.

1 THE CHAIRMAN: Yes, I think we will stop
2 then, because it is almost 4:30.

3 We will adjourn until tomorrow morning at
4 ten o'clock.

5 MR. WATSON: Thank you.

6 THE REGISTRAR: This hearing is adjourned
7 until tomorrow morning at ten o'clock.

8 ---Whereupon the hearing was adjourned at 4:27 p.m.,
9 to be resumed on Thursday, May 23, 1991, at
10 10:00 a.m.

E R R A T A
and
C H A N G E S

To transcript for Wednesday, the 21st day of May, 1991,
Volume 16.

<u>Page No.</u>	<u>Line No.</u>	<u>Discrepancy</u>
2762	9	effluence s/r effluents
2883	4	quota s/r closure

